REPORT OF THE CHIEF OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, 1936

United States Department of Agriculture,
Bureau of Entomology and Plant Quarantine,
Washington, D. C., September 15, 1936.

Hon. Henry A. Wallace,
Secretary of Agriculture.

Dear Mr. Secretary: I submit herewith a report of the work of the Bureau of Entomology and Plant Quarantine for the fiscal year ended June 30, 1936.

Sincerely yours,

Lee A. Strong, *Chief.*

CONTENTS

INTRODUCTION

The organization of the Bureau's activities is continued along substantially the same lines as that developed in connection with the reorganization authorized by the Secretary and approved by Congress for the fiscal year 1935. C. F. W. Muesebeck was designated leader of the Division of Insect Identification, replacing Harold Morrison, who is devoting his full time to the identification and classification of scale insects. The investigational work on Japanese and Asiatic beetles previously treated as a division, with field headquarters at Moorestown, N. J., has been made a part of the work of the Division of Fruit Insect Investigations. To coordinate and provide more effective direction of the various studies on fruitflies, which are potential pests of the United States, the investigational work on fruitfles carried on at various points outside the continental United States was brought together, effective December 10, 1935, to form the Division of Fruitfly Investigations, with A. C. Baker in charge and headquarters at Mexico City, Mexico. The work on the control of the screwworm was recognized as a separate field division, effective March 15, 1936, with W. E. Dove

in charge. The research on this pest remained in the Division of Insects Affecting Man and Animals.

Allotments from processing taxes collected in Hawaii and Puerto Rico provided for special investigations on insect pests in these two localities. The funds for work in Hawaii provided for studies of two different types on two fruitflies, the Mediterranean fruitfly and the melon fly. One of these included explorations to locate and import natural enemies, which may aid in reducing these pests. The other concerned the development of more effective ways of controlling these fruitflies or treating products that they may infest. These activities were directed under the subject-matter divisions, and brief statements of the results secured during the fiscal year are included under these headings. The investigations provided for in Puerto Rico covered a number of different subjects. They were headquartered at and carried on in cooperation with the Federal experiment station at Mayaguez. To coordinate the general administrative and business activities and provide for effective operation of these various activities, L. C. McAlister, Jr., was appointed administrative field leader, reporting direct to the Chief. Technical phases of the studies were, however, under the direction of six subject-matter divisions, to which, in the organization of the Bureau, the various problems would be assigned. The results secured by these studies are referred to under the appropriate sections of the report.

The work of a number of the activities concerned with the eradication or control of plant pests was materially expanded by allotments from emergency funds for relief. Allotments from emergency funds were also made available for work on certain activities for which there was no regular appropriation. The results of the work done under these special allotments are discussed under appropriate headings and include the following activities: Gypsy moth control, brown-tail moth control, Dutch elm disease eradication, barberry eradication, white pine blister rust control, citrus canker eradication, phony peach disease control, scouting to determine distribution of the European corn borer, eradication of wild cotton in Florida for protection against the pink bollworm, destruction of Thurberia plants in southeastern Arizona as an aid in the control of the Thurberia weevil, and eradication of peach mosaic.

Camps operated by the Civilian Conservation Corps also cooperated in the control of certain insects and plant pests against which eradication or control activities were being carried on. The work of these camps was administered through other agencies but coordinated with and made a part of the general control programs.

The need for special information in carrying on the activities of certain camps engaged in the control of forest insects made it necessary to conduct special research, and small allotments were made from Emergency Conservation funds to provide for this, the work being directed by the Division of Forest Insect Investigations. The need for information on insects attacking trees being planted in the shelterbelt required special studies on certain insect pests, and these were provided for under an allotment from special funds available for work in the shelterbelt.

Allotments from emergency funds were also used for certain types of physical improvements, including the repair of fumigation houses, the construction of insectaries and rearing cages, etc.

PUBLICATIONS AND EDITORIAL WORK

During the year 469 manuscripts were presented for publication and 451 were approved, 133 being submitted to the Department for publication and the remaining 318 to outside journals. The number of manuscripts submitted for consideration and approval has materially increased since the organization of the present Bureau of Entomology and Plant Quarantine. These remained on hand at the end of the fiscal year 103 manuscripts, 78 of which were under consideration in the Bureau, 9 were in the Office of Information awaiting publication by the Department, and the remaining 16 were in press at the Government Printing Office. Of the 78 in the Bureau, 26 were being considered for publication by the Department and the remaining 52 for publication in outside periodicals.

LIBRARY

The routine library activities connected with acquiring, recording, and making available for use the 30,477 books and pamphlets in the section of the Department library containing publications on entomology and under the care of the

Bureau have consumed most of the time of the library staff. The inclusion in the Bureau of the chemical work on insecticides has expanded to some extent the work and scope of the library. Approximately 8,800 references relating to various phases of work on economic entomology have been added this year to the current index, which now numbers some 37,000 references, for 1930–36. Special lists of publications dealing with 20 different subjects have been prepared for the use of employees of the Bureau. These include references to such subjects as the responses of insects to radio waves, the liquid-bait sprays used for Lepidoptera, and the effect of hibernation and diapause on insects. About 50 additions have been made to the collection of photographs of entomologists, which now totals approximately 2,700. The work of cataloging numerous books obtained in connection with the purchase of the Barnes collection of Lepidoptera has received special attention, and arrangements have been made for the exchange, through the Department library, of duplicate copies of publications secured as a part of this purchase. This will make more readily available for the use of entomologists copies of the check lists of Lepidoptera of North America and other contributions published by the late William Barnes and his associates, which had received only inadequate distribution at the time of Dr. Barnes' death.

INSECT PEST SURVEY AND INFORMATION

During the year the survey added to the permanent files on the distribution and abundance of insects 9,800 notes on American insect pests and 4,000 notes on foreign pests, bringing the total now available for consultation to 240,650. The monthly Insect Pest Survey Bulletin was augmented by supplements on The Colonization of Foreign Parasites of the European Corn Borer, Report on Status of the European Corn Borer in 1935, Hessian Fly Infestation at Harvest Time in 1935, and The Results of European Corn Borer Surveys in 1935.

One hundred and two articles on entomological and quarantine subjects were released to the press, and 69 radio talks were put on the air. The preparation of film strips covered 15 additional subjects. Three motion pictures have been in the process of making, but none had been completed by June 30. An exhibit on the activities of the Bureau, to be shown at the Texas Centennial Exposition at Dallas, Tex., was planned and supervised, as well as a small exhibit for the annual meeting of the American Medical Association at Kansas City, Mo.

Cooperative extension work in entomology was supervised under the direction of the Bureau and the Office of Cooperative Extension Work. Thirty-eight specialists were employed to carry on this work. In addition to these, 17 additional entomologists were used in carrying out chinch bug and grasshopper control campaigns.

Twelve numbers of the Bureau's monthly News Letter, comprising a total of 297 pages, were issued.

Approximately 130,000 publications were distributed, exclusive of those sent out on regular mailing lists and miscellaneous mimeographed material.

FRUIT INSECT INVESTIGATIONS

APPLE INSECTS

The funds allotted for work on apple insects are still being devoted chiefly to investigations of the codling moth. The task of finding an effective and unobjectionable substitute for lead arsenate or other fully effective means of control not requiring the use of poisonous insecticides is proving very difficult.

In the spring of 1936 a station was established at Poughkeepsie, N. Y., in cooperation with the New York Agricultural Experiment Station, to study codling moth control under the conditions of light infestation that exist in eastern New York and the New England States, and where the residue problem at harvest time is complicated by the necessity for dealing with the apple maggot, which has formerly been controlled by midsummer applications of arsenicals. The work of two of the apple-insect stations, Vincennes, Ind., and Yakima, Wash., is carried on jointly by the Divisions of Fruit Insect Investigations and Insecticide Investigations.

In the Middle West and East, owing largely to climatic conditions, the level of codling moth population during the crop season of 1935 was lower than it has been for a number of years. The most encouraging development of the season of 1935 was the high degree of codling moth control obtained by the use of phenothiazine, sometimes referred to as thiodiphenylamine, under conditions

existing in the Pacific Northwest. In the Middle West and East the results were less favorable, although sufficiently encouraging to warrant further work. The material, however, has certain disadvantages which must be overcome before it can be recommended for practical use. It is irritating to the skin of persons applying the spray, and to a lesser extent to other workers in trees to which applications have been made. More complete information is needed also on the effect of phenothiazine on the size and color of the fruit. Further work is being carried on with certain forms of the so-called fixed-nicotine combinations, special effort being made to develop combinations that do not leave unsightly residues on the fruit.

In experiments in the Northwest with chemically treated bands to determine more exactly the load of beta-naphthol and oil needed for full effectiveness in that area, a load of 0.32 ounce of the beta-naphthol-oil mixture per linear foot of 2-inch band destroyed practically all of the worms. In the Middle West and East 0.50 ounce of the standard formula per linear foot appeared necessary to prevent practically all emergence during the season. In the eastern experiments the addition of small quantities of aluminum stearate reduced by about 20 percent the quantity of chemical coating required.

Practical field experiments carried on in southern Indiana with a combination of orchard clean-up practices and banding have confirmed previous results, and indicated a reduction in infestation of fully 50 percent. Similar experiments have been started at Yakima, Wash.

Further field experiments have been carried on with numerous bait materials. In the Northwest the outstanding attractants have been 10 percent of molasses with 1 cc of pine-tar oil per quart, and 10 percent of brown sugar with one-half cubic centimeter of bromostyrol per quart. In southern Indiana the pine-tar oil-molasses mixture also gave good results, especially early in the season. Oil of mace, bromostyrol, and oil of sassafras with brown-sugar solution were about equally effective. Although the direct control value of bait traps is still problematical, they continue to be of great value to orchardists in the timing of their spray applications.

The extensive field experiments in utilization of the egg parasite *Trichogramma minutum* Riley, carried on at Cornelia, Ga., in cooperation with the Georgia State entomologist's office, and at Yakima, Wash., indicated a slight reduction in infestation as a result of liberations of this parasite. This reduction, however, was not significant from either a statistical or a practical standpoint, and the experiments were discontinued at the close of 1935. The important eastern codling moth parasite *Ascogaster quadridentatus* Wesm. has now been colonized in most of the important western apple-producing sections where formerly it did not occur. Arrangements are being made for the distribution to new areas of other parasite species, including *Phanerotoma tibialis* Hald. and *Aenoplex carpocapsae* Cushm. Experiments with a combination of mechanical control measures and efforts to stimulate the activities of parasites have been started in West Virginia, in cooperation with the West Virginia Agricultural Experiment Station.

Colonies of the woolly apple aphid parasite *Aphelinus mali* Hald. have been sent to a number of State agencies, including those in Utah, California, Colorado, New Mexico, and Kansas, for liberation in orchards infested with the woolly apple aphid.

A project on the control of the pear thrips on pears and prunes in the Pacific Northwest has been undertaken in cooperation with the Oregon Agricultural Experiment Station. This insect has been causing serious damage in certain areas in the Northwest, and the standard spray program has not been giving satisfactory control.

In tests against hibernating codling moth larvae, a 20-percent emulsion of pine oil alone killed 38 percent of the larvae, whereas the addition of 1 percent of alpha-naphthylamine increased the kill to 75 percent, and the addition of 1 percent of nicotine increased it to 100 percent. A number of other materials, including phenothioxin, orthodichlorobenzene, rotenone, diphenyl oxide, diphenyl sulphide, and orthonitroanaline, failed to increase the effectiveness of pine oil against hibernating codling moth larvae.

PEACH INSECTS

Major attention has been given to the introduction and colonization of foreign and domestic parasites of the oriental fruit moth. The work with bait traps for fruit moth control has been curtailed and the funds used to support the work of distribution and recovery of parasites in the middle western areas of infestation.

Ten shipments of parasitized material from Japan, received in the summer of 1935, yielded 31,384 parasites belonging to 14 different species. Thirteen of these species were liberated in 103 colonies in important peach-growing districts in 7 Eastern States. In addition, 10 colonies of native species were liberated in 2 States where they were not already established. Recovery collections have been made, in many cases with the cooperation of State agencies, in 16 States where parasites had been liberated before.

Field experiments in 1935 in control of the peach borer confirmed earlier favorable results with emulsions of cottonseed oil impregnated with paradichlorobenzene. An emulsion of ethylene dichloride gave even better control of this borer without injury to the trees and at a somewhat lower cost. Studies of the biology of the peach borer have indicated that in Georgia a small percentage of the population produces a second generation the same year, and that a few of the moths continue to deposit eggs later than was formerly thought.

With the plum curculio, experiments in the 1936 season are being carried on with ground derris root and with schedules calling for the use of fluorine compounds in part of the spray program and lead arsenate in the rest, in the hope of avoiding injury by the fluorine compounds and excessive poisonous residues.

In experiments in the winter of 1935–36 five different blended oils gave approximately as good control of the San José scale as straight-run oils of similar specifications used at the same strengths. Oils having volatilities of 8 to 12 percent were definitely less effective in scale control than otherwise similar oils having volatilities below 5 percent.

GRAPE INSECTS

Phenothiazine gave a fair degree of control of the grape berry moth, but caused considerable russeting on some of the grape clusters. This injury may have been due in part to the use of fish oil with the phenothiazine. Slight foliage injury developed on the vines sprayed with phenothiazine with fish oil but no injury where the phenothiazine was used alone. Several calcium arsenates, prepared according to definite specifications, gave a fair degree of control. Nicotine bentonite, in the 1935 experiments, seemed inferior to arsenicals in control of the berry moth.

In connection with the destruction of hibernating grape leafhoppers (*Erythroneura comes* Say and related forms) in their winter quarters near the vineyards, it has been noticed that the hoppers are attracted in large numbers, and sometimes for considerable distances, to pomace heaps from wine presses located near the vineyards, the insects then hibernating in the pomace and in trash and weeds nearby. The burning over of pomace heaps and surrounding areas destroyed great numbers of the insects.

In connection with field experiments carried on with various materials primarily for the control of the grape berry moth, observations are being made on the effect of these materials on the beetles of the grape rootworm. Calcium arsenate and lead arsenate continue to hold the infestations at a minimum. Certain of the nonarsenical materials, particularly those including nicotine and pyrethrum, appear to have little effect on adults of the grape rootworm.

NUT INSECTS

Experiments in 1935 carried on by the Albany, Ga., station gave further proof of the effectiveness of late-spring spraying with nicotine sulphate combined with summer oil emulsion or with fish oil in the control of the pecan nut casebearer, although the average control resulting was only 75 to 85 percent, as compared with better than 90 percent in previous years. The use of nicotine with bordeaux mixture gave results nearly as satisfactory. In the Brownwood, Tex., district nicotine sulphate with oil gave reductions in infestation averaging 95 percent. In that area lead arsenate has continued to give effective control and appears to be fairly safe on pecan foliage.

Further experiments have been carried on with bordeaux mixture as a corrective for injury by calcium arsenate, which is used in summer sprays for the control of the pecan casebearer. Bordeaux mixture at a strength as low as 1½–50 was satisfactory in preventing injury to the foliage by calcium arsenate, but the application of a concentration even as low as this was followed by an increase in infestation by the black pecan aphid.

Work was carried on in 1935 to determine the extent to which the hickory shuckworm may be controlled in pecan plantations by plowing under the shucks,

in which the insect hibernates. Cage tests showed that if the plowing is done in winter, when the insect is in the larval stage, little control is likely to result. On the other hand, the burial of the shucks in the spring, when the larvae within them had transformed to pupae, prevented nearly all subsequent emergence of the moths.

The rearing technique for the production of the egg parasite *Trichogramma minutum* was carried to a very high state of effectiveness, over 63,000,000 parasites having been produced at the Albany, Ga., station in 1935. Unfortunately, the results of the field experiments were unsatisfactory on the whole, and it is believed that this method of controlling pecan insects cannot be employed profitably by the practical grower. The work with the utilization of *Trichogramma* has, therefore, been discontinued. As opportunity offers, however, attention will be given to other parasites of pecan insects.

Further experiments in 1935 with the use of oil sprays on dormant pecan trees have confirmed earlier results indicating that pecan trees are particularly susceptible to injury by oil sprays, especially if the trees are low in vitality, and on the lower branches of closely planted, large trees. The experiments in 1936 included tests of oils of various specifications, including the highly refined oils, emulsified with different materials and in different ways and applied at different times, to determine the influence of the various factors on the control of the scale, on injury by the oil, and on nut yield.

With the pecan phylloxera (*Phylloxera devastatrix* Perg. and other species), control tests have confirmed previous results and have indicated that the most common species of phylloxera on pecans in the South may be well controlled by spraying early in the spring with nicotine sulphate, combined with either soap or with liquid lime-sulphur. Biological studies are under way with a number of less well known species of phylloxera.

DRIED-FRUIT INSECTS

Further confirmation was obtained of former observations indicating that effective protection against attack by certain dried-fruit insects may be obtained by use of tobacco shade cloth during the period when the fruits are drying in stacked trays in the field. Infestation in drying pears by the raisin moth (*Ephestia figulilella* Greg.) and the dried-fruit moth was reduced more than 90 percent by this means. Excellent protection for boxed raisins resulted from the same method, which also reduced fly-specking on drying apricots. Further extensive tests of a motor-driven shaker screen for sifting raisins to remove moth infestation gave a reduction in infestation of seedless raisins averaging 78 percent. It is believed that this machine can be modified to do even more effective work. A combination of the two control measures just mentioned should give a high degree of freedom from infestation by the raisin moth.

A comparison of two methods of drying raisins—on wooden trays and on paper trays which are rolled into rather tight packages before drying is completed—showed that infestation by the raisin moth was nearly five times as great on wooden trays as on papers.

Detailed records of seasonal emergence of the adult raisin moth showed that 94 percent of the spring generation appear while mulberries are the only widely distributed food material available to them. Collected samples of mulberries showed the presence in some cases of more than a million raisin moth larvae per ton during a period when most of the insects would otherwise die of starvation. This serves to emphasize the importance of mulberries in the life history of this insect.

Experiments in the fumigation of individual packs indicate that complete control of the raisin moth and Indian-meal moth can be obtained with mixtures of three parts of ethylene dichloride and one part of ethylene oxide, the dosage being 7 cc for each 25-pound box of raisins. In certain tests 100-percent mortality was obtained with a 5-cc dose of the same mixture. Methyl bromide killed all insects at a dosage of 4 cc for each 25-pound box.

Studies of the dispersal habits of the dried-fruit beetle, carried on by the liberation of large numbers of marked insects and their subsequent recovery in traps, showed that under certain conditions the beetles may migrate more than 2 miles within a period of 4 days. Unmarked beetles were taken at points more than 3 miles from any known source of infestation.

Further experiments have been carried on in cooperation with the Bureau of Plant Industry to develop methods of disinfecting caprifigs containing

Blastophaga, the fig-pollinating insect. Although no completely effective method of freeing the figs or the *Blastophaga* wasp from spoilage micro-organisms can yet be recommended, definite progress has been made.

SUBTROPICAL FRUIT INSECTS

In two experiments in Florida in the control of the citrus rust mite on orange trees, the addition, to the standard lime-sulphur solution, of aluminum sulphate with hydrated lime as an adhesive was found to prolong the spray protection considerably, so that fewer sprayings were necessary during the year. Wettable sulphur as a spray, without adhesives, was distinctly inferior to lime-sulphur, but with these adhesives it was a promising control mixture. Control of the rust mites was obtained also with two applications of sulphur dust from a ground dusting machine. This method of control compared favorably with spraying, although in one case heavy rains necessitated redusting in a week's time. Even in this plot three dustings sufficed for the season.

Extensive field experiments have been carried on in the control of the orange thrips. In the Redlands-Rialto section of California three applications of sulphur dust have continued to give control better than that obtained by a single application of liquid lime-sulphur. Sulphur dusts containing compounds of zinc (used for the control of the condition known as mottle-leaf), in proportions ranging from 4.5 to 11 percent, on a basis of metallic zinc, seemed as effective in thrips control as sulphur dust alone. Little control of the thrips was obtained by the use of dusts of derris, pyrethrum, or rotenone with inert carriers. Experiments in dusting with sulphur for thrips control were also carried on in the Salt River Valley of Arizona.

Work with the California red scale has been continued in southern California, in cooperation with the Division of Insecticide Investigations. A long series of field fumigations has been carried on in accordance with commercial practice and record made of all conditions that might influence their effectiveness. Gas samples were taken at intervals from under four tents at each treatment to determine the concentrations through the period of treatment, and detailed records were made of the proportions of the scale insects in various stages, of the mortality resulting from the treatment, and of the effect of the treatment on the trees and fruit and also on the subsequent yield.

The experiments carried on in cooperation with the Bureaus of Plant Industry and Chemistry and Soils to determine the effect of tartar emetic when used as an insecticide spray on citrus trees have been continued. In general, the results obtained thus far seem to indicate that tartar emetic applied as a mist spray at strengths up to and including 8 pounds per 100 gallons of spray mixture has little or no effect on citrus foliage or fruit.

THE RHINOCEROS BEETLE IN PUERTO RICO

The rhinoceros beetle *Strategus quadrifoveatus* Beauv. is the most serious pest of coconuts in Puerto Rico. It attacks and finally kills approximately 75 percent of the young replanted palms during the first 3 years of their life. In studies carried on with special funds emphasis was placed on the development of control measures. Two of the most promising and economical methods of control are (1) wrapping the nut and the lower 5 inches of the sprout of the seedling palm with ½-inch square mesh, galvanized-iron wire hardware cloth before planting, and (2) grove sanitation in which all decayed wood, particularly that of coconut and other palms, is destroyed. The former method has given immediate and absolute protection that will probably last beyond the most vulnerable period in the life of the palm at a cost of about 25 cents per palm. From the data thus far obtained on the latter method it appears that grove sanitation will be commercially effective beginning approximately 6 months after its initiation, provided it is carried out carefully and on a community or sectional basis.

COFFEE INSECTS IN PUERTO RICO

The investigations on coffee insects in Puerto Rico were directed principally to the relationship between ants and scale insects and mealybugs. Two species of ants were frequently found associated with infestations of scale insects on coffee, but neither of these appears materially to affect the scale population through protecting the scales from parasites or predators.

A survey has been made of the parasites of the coffee leaf miner (*Leucoptera coffeella* Guer.).

THE PINEAPPLE MEALYBUG IN PUERTO RICO

A survey of Puerto Rico showed that the pineapple mealybug is well distributed in varying degrees over the island on pineapple and 11 other host plants, mostly weeds and grasses in and near pineapple fields. The fire ant was found to be the most widely distributed of 14 species of ants seen attending the mealybug on pineapple plants. *Pheidole megacephala* F., the most abundant ant attending this species in Hawaii, was not found associated with it on pineapple in Puerto Rico.

JAPANESE AND ASIATIC BEETLES

Population studies carried on in New Jersey and nearby States indicated an increase of approximately 1,700 square miles in the area generally infested by the Japanese beetle at the close of 1935. The population in the older infested areas has continued to show more or less of a decrease. During the winter of 1935–36 mortalities of 50 percent or more among larvae in the ground occurred in the area south of Philadelphia and in southern New Jersey. The lack of snow cover and the presence of ice on the surface of the ground during the period of low temperatures seem to have been factors contributing to this unusual mortality.

Many materials were tested in comparison with acid lead arsenate as stomach poisons or repellents for the Japanese beetle, including compound arsenates of the alkali and alkaline earth metals, homologues of paris green, organic sulphur compounds, and other materials, but no outstanding substitute for acid lead arsenate was found. The year's work further demonstrated that early ripening apples can be protected from beetle attack to a considerable extent by the use of a spray of lime and aluminum sulphate, the residue remaining being nontoxic and readily removed. Protection of early ripening peaches was again obtained by applications of a repellent spray composed of derris and rosin-residue emulsion, which leaves a nontoxic and inconspicuous residue. Control of the adults on asparagus brush was obtained with a spray consisting of lime, aluminum sulphate, and sodium lauryl sulphate, when it was applied frequently enough to keep the new growth covered. Cakes of pumice, clay, or porcelain were found to be satisfactory substitutes for bottle and wick for dispensing the geraniol bait in Japanese beetle traps.

A large number of organic and inorganic materials, including a number of arsenicals, fluorine compounds, and such organic substances as pyrethrum, rotenone, and hellebore, were tested under laboratory conditions to determine their relative value as stomach poisons against third-instar larvae of the Japanese beetle, but no satisfactory substitute for acid lead arsenate was found. A study of the effect of arsenicals on larvae in the soil showed that as soon as arsenic is ingested the larvae stop feeding and lose weight. It was found that when applied as a top dressing lead arsenate was equally effective in protecting turf, whether applied as a spray or mixed with sand, tankage, or activated sludge, but that when used with a complete fertilizer or green-sand marl the effectiveness of the treatment was decreased.

The use of lead arsenate for the control of Japanese beetle larvae in the soil of seedbeds in coniferous-tree nurseries did not prevent germination of the seed, but in most cases it interfered seriously with the growth of the seedlings, and it appears to be a questionable practice. Cultivators of the ordinary type were found to have relatively little value in reducing larval populations whereas those of the rotary type were very much more effective for this purpose.

Paradichlorobenzene was successfully used as a fumigant for destroying larvae about the roots of azaleas and certain other plants of the same type, and this treatment has been approved as a method of meeting quarantine requirements for these plants.

Studies have been made of methods of applying lead arsenate to nursery soil for the protection of growing nursery stock. Hoeing out the soil between the plants previous to treatment, then sweeping the soil back into the rows after the chemical has been distributed, placed about two-thirds of the poison in the rows about the plants. The most uniform distribution was obtained by applying the lead arsenate by means of a hand duster over all of the area to be treated.

The several types of disease organisms found among Japanese beetle larvae in the soil have been classified into four general groups—the black group and the white or "milky" group (both caused by bacteria or protozoa), the fungus group, and the nematode group. Particular attention has been given to the

white group, which appears to be responsible for the most important type of disease encountered. Experimental field plots have been laid out in which larvae have been inoculated in different ways with disease organisms to determine the possibility of utilizing these organisms for the control of the beetle.

The work with the parasites of the Japanese beetle has been continued. Up to and including the calendar year 1935, something over 1,100 colonies of imported parasites have been released in the field. Of this number, 294 new colonies were released in 1935. During the year, 195 selected colonies were surveyed to determine their status, 110 of which showed definite establishment, most of these being in a very flourishing condition. Three shipments of new material from the Orient were received during the year, 6,372 individuals arriving alive and in good condition. Certain of the parasites which are effective in oriental countries, especially *Centeter cinerea* Ald. and *Tiphia popilliavora* Roh., are poorly synchronized with the development of the host under conditions in the Moorestown, N. J., area. It is believed that conditions in this respect will be better in more northern regions. In order to facilitate the work with parasites in the northeastern part of the United States, a substation has been established at Springfield, Mass. This will be used as a center for colonization work as well as for studies of the biology of the parasites and of the host.

To keep in touch with conditions existing in more western areas newly occupied by the Japanese beetle, an investigator is being stationed in the Middle West, where a special study will be made of the local infestations that have been discovered at various points, including St. Louis and Chicago.

Investigations on the Asiatic garden beetle have been restricted, attention having been given largely to the development of nonpoisonous repellent materials for use in vegetable gardens, where sprays leaving poisonous residues on the plants cannot be used. Those showing greatest promise were hydrated lime dust and a spray of hydrated lime with aluminum sulphate.

FRUITFLY INVESTIGATIONS

In December 1935 the investigational work on fruitflies which are a potential menace to the mainland of the United States was brought together in a separate division, with field headquarters at Mexico City. Studies have been continued at laboratories in Mexico, Hawaii, Puerto Rico, and the Canal Zone. Those in Hawaii and Puerto Rico were materially expanded by special funds, largely allotments from processing taxes.

The investigations carried on in Mexico have dealt with several species of fruitflies of the genus *Anastrepha*, with particular emphasis on the Mexican fruitfly (*A ludens* Loew) and *A. serpentina* Wied. In addition to laboratory studies of the type conducted in previous years, field experiments have been carried on at Santa Engracia to secure data on the effectiveness of various sweetened sprays and attractants used in traps, and to obtain information on various hosts and their effect on the abundance of the flies within orchards. In these field tests the sweetened sprays containing tartar emetic as a poison proved to be more effective than any others tested. Laboratory studies in Mexico City have shown that *A. serpentina*, a fruitfly that has recently appeared farther north in Mexico, can survive freezing temperatures, can live many months, and can reproduce as abundantly as the Mexican fruitfly.

During the year the investigations conducted in Hawaii were extended to include the melon fly as well as the Mediterranean fruitfly. Experiments to determine the effect of low temperatures on the immature stages of the Mediterranean fruitfly that occur in fruit have been continued, and sufficient data have been obtained at temperatures of 30° to 32° F. to conclude the tests at these temperatures. In the investigations on baits and attractants during the last part of the year special attention was directed to the testing, against the Mediterranean fruitfly, of certain protein baits developed in the laboratory at Mexico City. The tests so far conducted suggest that these are three or more times as attractive to the fly as any other baits tested. Experiments have been carried on to determine the effect of vacuum and fumigation on the immature stages of the larvae within various fruits. Many fumigants have been eliminated; preliminary tests with others, however, suggest their possible usefulness.

In Puerto Rico various insecticides and attractants developed at other laboratories have been tested to determine their effectiveness on the two forms of the West Indian fruitfly which occur in that island. The insecticide tartar

emetic continues to be more effective than others. Allotments from special funds, including those received from the Emergency Relief Administration in Puerto Rico, provided for constructing and equipping special rooms for experiments to determine the effect of high and low temperatures on the immature stages of fruitflies in various kinds of fruit. This equipment was ready for use late in the year. The tests conducted at 32° F. suggest that the immature stages of these fruitflies are killed at this temperature as readily as are those of the Mexican and the Mediterranean fruitflies.

In the Canal Zone the habits of various species of fruitflies that occur naturally in that locality have been studied. Adults of *A. serpentina*, a species that usually confines its attacks to sapotes, have been reared from oranges purchased in the market, indicating that this form attacks citrus fruit under natural conditions.

MEXICAN FRUITFLY CONTROL

INFESTATIONS

ADULTS

Traps have become increasingly imporant in determining the extent of adult infestations of the Mexican fruitfly (*Anastrepha ludens* Loew) in Texas and in indicating probable larval infestations. Through the use of these traps adults were taken monthly from September through May from 196 premises. The 256 specimens trapped represent a decrease of 115 from the previous year's total; however, there was an increase of 17 in the total number of premises infested. The length of time over which adults were trapped also increased 2 months over the previous year, as flies were trapped as early as September in 1935.

As in former years, the greatest concentration of infestations was in the western half of the Rio Grande Valley from La Feria toward Mission. This has been observed not only this year but also in previous seasons, and the same condition holds for all other species trapped as well as for *Anastrepha ludens*.

Included in the total number of adults trapped are 20 from 12 locations in northern Hidalgo and Brooks Counties and 8 from 4 premises in Starr and Webb Counties.

Trapping results throughout the year are presented in table 1.

TABLE 1.—*Fruitflies trapped in Texas, fiscal year 1936*

District	*Anastrepha ludens*		*Anastrepha serpentina*		*Anastrepha acidusa*		*Anastrepha* sp. *X*		*Anastrepha* sp. *Y*	
	Adults	Premises	Adults	Premises	Adults	Premises	Adults	Premises	Adults	Premises
Mission	25	23	15	14	6	5	2	2	11	11
McAllen	25	19	13	12	10	8	1	1	9	8
Edinburg	27	19	22	18	12	8	0	0	20	11
Pharr-San Juan-Alamo	33	21	17	13	14	14	0	0	20	14
Donna	20	14	20	17	6	6	1	1	17	14
Weslaco	22	20	37	27	13	12	0	0	11	8
Mercedes	21	19	24	16	8	8	0	0	18	14
La Feria	28	21	17	13	6	5	0	0	18	15
Raymondville	7	5	3	3	1	1	0	0	14	8
Harlingen	9	9	1	1	6	6	0	0	16	10
San Benito	8	7	13	12	5	4	0	0	14	13
Brownsville	3	3	16	12	4	4	0	0	30	16
Falfurrias and northern Hidalgo	20	12	1	1	2	2	0	0	16	9
Starr and Webb Counties	8	4	4	4	4	2	0	0	1	1
Total	256	196	203	163	97	85	4	4	215	152

TABLE 1.—*Fruitflies trapped in Texas, fiscal year 1936*—Continued

District	*Anastrepha* sp. seg. no. 3		*Anastrepha* sp., near *ludens*		*Anastrepha pallens*		*Toxotrypana curvicauda*		Total specimens
	Adults	Premises	Adults	Premises	Adults	Premises	Adults	Premises	
Mission	0	0	1	1	322	(1)	15	15	397
McAllen	0	0	0	0	321	(1)	11	10	390
Edinburg	0	0	0	0	2,231	(1)	1	1	2,313
Pharr-San Juan-Alamo	0	0	1	1	254	(1)	10	7	349
Donna	0	0	0	0	405	(1)	3	2	472
Weslaco	0	0	1	1	525	(1)	16	13	625
Mercedes	0	0	0	0	623	(1)	4	3	698
La Feria	1	1	0	0	290	(1)	12	8	372
Raymondville	0	0	0	0	215	(1)	0	0	240
Harlingen	0	0	0	0	392	(1)	4	4	428
San Benito	0	0	0	0	238	(1)	0	0	278
Brownsville	0	0	0	0	37	(1)	3	2	93
Falfurrias and northern Hidalgo	0	0	0	0	108	(1)	1	1	148
Starr and Webb Counties	0	0	0	0	19	(1)	1	1	37
Total	1	1	3	3	5,980	(1)	81	67	6,840

[1] Premises for *A. pallens* are not shown, as this species is usually taken wherever traps are set.

LARVAE

Larval infestations were found in four districts on five premises during the year. This represents a decrease of 25 premises from the previous year.

Usually larval infestations, if any, occur during the early spring months. This past season, however, all of them were found in November and December. After the fruit had been removed from these premises and the trees sprayed, no other larvae were found throughout the remainder of the shipping season.

The details as regards larval findings are shown in table 2.

TABLE 2.—*Infestations of Anastrepha ludens in Texas, fiscal year 1936*

District	Larvae taken	Premises	District	Larvae taken	Premises
Mission	3	1	Weslaco	20	1
McAllen	54	1			
Edinburg	125	2	Total	202	5

OTHER SPECIES OF ANASTREPHA TRAPPED

As in preceding years, several species of *Anastrepha* other than *ludens* were taken wherever traps were operated. Continued inspections of wild and cultivated fruits have failed to establish a host for any of these flies except *A. pallens*. Apparently *pallens* is confined to one brush fruit of no economic importance. If any of these other flies have local hosts, they also are of no economic importance.

FIELD INSPECTIONS

The main phases of field work are grove inspection for infested fruit and unsanitary conditions, packing-house inspection, trapping, removal of alternate-host fruit trees and fruit, and tree-to-tree inspection at the beginning of the host-free period.

Since many thousands of trees have come into bearing within the year, it became necessary to add 10 seasonal men to the personnel of this force from January through April. With these additional inspectors it was possible to intensify inspections and to operate more traps.

The total grove and trap inspections are shown in table 3. Traps operated monthly averaged 8,149. A total of 41,388 alternate-host fruit trees have been removed since the beginning of the project.

TABLE 3.—*Summary of inspections for the Mexican fruitfly in Texas, fiscal year 1936*

Month	Groves inspected	Premises trapped	Traps operated	Trap inspections made	Secondary-host fruit	
					Trees destroyed	Premises cleaned
July	57	584	8,611	35,016	0	0
August	888	542	8,475	33,445	4	2
September	901	650	8,889	28,769	2	1
October	2,469	613	8,243	35,637	3	3
November	4,503	500	7,452	29,727	0	0
December	3,700	522	7,505	27,066	2	2
January	6,643	704	7,995	29,568	5	2
February	5,072	654	7,198	25,085	0	0
March	4,474	429	7,659	31,472	3	2
April	130	420	7,770	28,971	92	28
May	282	528	8,983	33,333	525	65
June	592	523	9,012	38,408	25	10
Total	29,711	6,669	97,792	376,497	661	115

SPRAYING OPERATIONS

The regular procedure, after a larval or adult infestation is found, is to spray the trees on the infested property with a nicotine sulphate-molasses spray. Two spray rigs were kept in operation whenever necessary. The materials were used as follows: Nicotine sulphate 175¼ gallons, molasses 3,505 gallons. Table 4 gives spraying operations by months, and totals.

TABLE 4.—*Summary of spraying operations for the Mexican fruitfly in Texas, fiscal year 1936*

Month	Trees sprayed	Premises sprayed	Material used	
			Nicotine	Molasses
	Number	*Number*	*Gallons*	*Gallons*
October	320	1	1.50	30
November	6,400	16	40.25	805
December	4,524	5	15.75	315
January	11,702	22	32.75	655
February	25,275	71	70.00	1,400
March	4,000	10	15.00	300
Total	52,221	125	175.25	3,505

STUDIES OF ALTERNATE HOSTS

Since the inception of this work, studies have been made of the wild fruits growing in this area to determine if any of them are being used as hosts by *Anastrepha ludens*. These fruits have been examined in the field and large quantities sent to the laboratory at Harlingen for observation over pupation trays. Within the year 1,683 collections were made. With the exception of the recovering of pupae of *A. pallens* from *Bumelia angustifolia*, all results have been negative.

EXPERIMENTAL SPRAYING

Experimental spraying work, in cooperation with the Bureaus of Plant Industry and Chemistry and Soils, was continued during 1936. A tartar emetic spray was applied to trees on a leased property according to a schedule furnished by the cooperating bureaus. In addition to making the spray applications, members of this project picked and shipped fruit for storage and chemical analysis and made packing-house tests of the fruit for spray damage.

CANNING PLANTS

The year saw a rapid development of the citrus-canning industry in the Rio Grande Valley, 1,627.7 equivalent carloads of grapefruit being canned. This development has added the new responsibility of seeing that all canning-plant debris is properly sterilized or buried.

To sterilize this waste material thoroughly, it was necessary to furnish technical assistance in the development of specialized equipment. Steam equipment that brings the mass of fruit rinds to 145 F°. or above quickly and cheaply was devised. This type of equipment is now generally installed in all canning plants operating in this area.

ACTIVITIES IN MEXICO

As in previous years, one full-time inspector, with a laborer, has been stationed in Matamoros and one part-time inspector has been employed in Reynosa, Mexico. The duties of these inspectors are to inspect locally grown fruit and fruit brought from the interior for local consumption, to operate traps, and to spray infested properties whenever necessary.

These operations have been carried on throughout the year with the result that, in spite of infested fruit being shipped into the markets almost daily, no local larval infestations have developed and none has developed within the last 3 years. Table 5 gives in detail the results of trapping and fruit inspection in Mexico.

TABLE 5.—*Adults of Anastrepha spp. trapped and larvae of the same collected in Mexico, fiscal year 1936*

Location	Adults trapped						Larvae collected				Total
	Anastrepha ludens	*Anastrepha acidusa*	*Anastrepha serpentina*	*Anastrepha* species *Y*	*Anastrepha pallens*	*Toxotrypana curvicauda*	*Anastrepha ludens*	*Anastrepha acidusa*	*Anastrepha serpentina*	*Anastrepha striata*	
Matamoros	25	3	0	14	12	0	3,570	2,856	8	3	6,491
Matamoros brush	2	0	0	1	1	3	0	0	0	0	7
Reynosa	11	1	0	0	1	0	1,089	14	4	0	1,120
Reynosa brush	23	2	3	15	317	9	0	0	0	0	369
Total	61	6	3	30	331	12	4,659	2,870	12	3	7,987

In addition to the regular work carried on in the border cities of Matamoros and Reynosa, trapping operations were inaugurated in the brush lands south of the river. These traps were placed from 25 to 75 miles south of the border for the purpose of determining whether fruitflies were present in the brush at the time they were being caught in Texas groves.

These trapping observations soon demonstrated that *Anastrepha ludens* and the other species of fruitflies generally taken in the valley were also present in the brush lands of northern Mexico many miles distant from any known hosts.

ROAD TRAFFIC INSPECTION

For the purpose of enforcing quarantine regulations, a road traffic inspection station, operated on a 24-hour basis, was established at the Brooks County line on the Edinburg-Falfurrias highway on October 12, 1935, and continued through March 11, 1936. It is estimated that 97 percent of the fruit hauled out of the valley by truck passes over the Edinburg-Falfurrias highway. However, to discourage violations of quarantine regulations by truckers who might take the longer route by way of Rio Grande City and Laredo, a road traffic inspection station was opened at Rio Grande City with one inspector on duty whose hours were staggered so as to subject road traffic to possible inspection at any hour of the day or night. No violations of quarantine regulations were encountered at the Rio Grande City road station, so it was not deemed necessary to increase the manpower at this station at any time during the past shipping season. The Rio Grande City road station was opened on November 14 and closed on February 29. Details of road traffic inspection through the Edinburg-Falfurrias road traffic inspection station are shown in table 6.

TABLE 6.—*Road traffic inspection in Texas, fiscal year 1936*

Month	Permits passed	Trucks passed	Trucks returned for permits	Grapefruit passed—		
				In boxes	In bulk	In sacks
	Number	*Number*	*Number*	*Boxes*	*Bushels*	*Pounds*
October	888	764	2	13,135	50,727	135,470
November	2,437	1,808	1	17,647	90,689	1,309,820
December	3,891	2,875	0	18,086	95,973	2,039,530
January	3,754	2,776	0	19,215	105,758	2,596,510
February	3,007	2,292	0	17,288	84,507	2,011,880
March	702	573	0	6,898	20,629	463,380
Total	14,679	11,088	3	92,269	448,283	8,556,590

Month	Oranges passed—			Tangerines passed—			Fruit confiscated
	In boxes	In bulk	In sacks	In boxes	In bulk	In sacks	
	Boxes	*Bushels*	*Pounds*	*Boxes*	*Bushels*	*Pounds*	*Packages*
October	629	14,972	11,080	0	366	240	12
November	2,675	62,432	228,090	27	9,431	6,050	21
December	9,184	150,919	424,224	153	24,521	5,930	5
January	9,416	148,783	503,490	4	3,339	1,480	45
February	10,138	123,255	654,310	0	578	480	21
March	2,463	25,270	93,840	0	24	0	0
Total	34,505	525,631	1,915,034	184	38,259	14,180	104

SHIPMENT OF FRUIT

The shipping season of 1935–36 opened on October 10 and the harvesting season closed March 31. The last fruit to leave the valley by rail was one carload of grapefruit on March 28. Infrequent truck shipments continued until April 13. Owing to good demand, movement of fruit continued brisk from the opening of the season until March 15, by which date very little fruit was left.

Rail shipments for the season were 3,730 cars of grapefruit, 325 cars of oranges, and 557 cars of mixed citrus, for a grand total of 4,612 carloads. In addition, 118 rail permits were issued for fruit shipped with vegetables. These rail shipments account for 4,656 equivalent carloads The basis used in computing equivalent carlots was 372 boxes, 575 bushels, or 32,640 pounds in sacks. A total of 15,709 permits for shipment of fruit by truck were issued during the season, shipments by truck being equivalent to 2,582 carlots. Shipments by express are estimated at 267 equivalent carlots. This makes a grand total for the season of 7,505 equivalent carlots, exclusive of 1,628 equivalent carlots of fruit used by canners for processing. Data relating to production and shipments are given in tables 7 and 8.

TABLE 7.—*Equivalent carlot shipments of citrus fruit from lower Rio Grande Valley, and total production in stated years*

(Based on 360 80-pound boxes to a carload)

Shipping season	By rail		By truck		Total rail	Total truck	Total express	Total shipped	Total canned	Commercial production
	Grapefruit	Oranges	Grapefruit	Oranges						
	Carlots	*Carlots*	*Carlots*	*Carlots*	*Carlots*	*Carlots*	*Carlots*	*Carlots*	*Carlots*	*Carlots*
1921–22	------	------	------	------	11	------	2	13	------	13
1922–23	------	------	------	------	44	------	------	44	------	44
1923–24	------	------	------	------	98	------	------	98	------	98
1924–25	------	------	------	------	448	------	1	449	------	449
1925–26	------	------	------	------	251	------	158	409	------	409
1926–27	------	------	------	------	651	------	166	817	------	817
1927–28	------	------	------	------	875	274	163	1,312	------	1,312
1928–29	------	------	------	------	1,696	430	226	2,352	------	2,352
1929–30	------	------	------	------	3,846	616	230	4,692	56	4,748
1930–31	------	------	------	------	2,785	868	206	3,859	155	4,014
1931–32	------	------	------	------	5,874	1,846	149	7,869	286	8,155
1932–33	2,897	230	880	586	3,127	1,466	101	4,694	127	4,821
1933–34	1,748	114	1,236	877	1,862	2,113	99	4,074	240	4,314
1934–35	4,617	225	1,731	1,095	4,842	2,826	239	7,907	1,131	9,038
1935–36	4,262	600	1,454	1,182	4,862	2,636	267	7,765	1,682	9,447

TABLE 8.—*Car-lot shipments of citrus fruit from the lower Rio Grande Valley, Tex., and total production in stated years*

Shipping season	Shipments by rail				Equivalent 80-pound boxes				
	Grapefruit	Oranges	Mixed citrus	Mixed fruit and vegetables	By rail	By truck	By express	Canned	Total
	Carlots	*Carlots*	*Carlots*	*Carlots*	*Boxes*	*Boxes*	*Boxes*	*Boxes*	*Boxes*
1921–22	7	1	5	----	4,030	----	620	----	4,650
1922–23	44	----	7	----	15,810	----	----	----	15,810
1923–24	107	----	7	----	35,340	----	----	----	35,340
1924–25	508	1	11	----	161,200	----	310	----	161,510
1925–26	290	1	----	----	90,210	----	56,865	----	147,075
1926–27	706	11	39	----	234,360	----	59,768	----	294,128
1927–28	1,042	27	86	----	314,960	98,710	58,820	----	472,490
1928–29	1,604	26	124	----	610,392	154,860	81,202	----	846,454
1929–30	3,491	116	372	----	1,384,692	221,676	82,775	20,000	1,709,143
1930–31	2,502	98	222	119	1,002,588	312,504	74,026	55,850	1,444,968
1931–32	5,318	194	492	146	2,114,796	664,680	53,493	102,800	2,935,769
1932–33	2,666	93	257	62	1,125,594	527,980	36,424	45,605	1,735,603
1933–34	1,602	63	121	29	670,275	760,549	35,590	86,320	1,552,734
1934–35	4,248	138	186	38	1,743,240	1,017,322	85,891	407,300	3,253,753
1935–36	3,730	325	557	118	1,750,368	949,291	96,120	605,504	3,401,283

Most of the crop moved to market in the standard 80-pound box. Eight carloads were shipped in the new 100-pound box and 10 carloads in the new 50-pound or bushel box. The equivalent of 866 carlots were shipped in waterproof mesh sacks. Oranges constituted 25 percent of the total fruit shipped.

A total of 3,793 shipments were made by truck during the year to points outside of Texas. The States, together with the number of shipments to each, are as follows: Oklahoma, 1,376; Arkansas, 397; Missouri, 442; New Mexico, 103; Nebraska, 118; Kansas, 542; Colorado, 269; Louisiana, 464; Illinois, 12; North Dakota, 1; South Dakota, 5; Mississippi, 23; Indiana, 8; Maryland, 1; Michigan, 9; Minnesota, 2; Ohio, 3; Alabama, 1; Georgia, 1; Kentucky, 2; Maine, 1; Montana, 3; New York, 3; Tennessee, 3; Wisconsin, 1; Virginia, 1; Pennsylvania, 1; and Iowa, 1.

WEST INDIAN FRUITFLY AND CITRUS BLACKFLY

The Second Deficiency Appropriation Act for the fiscal year 1935 provided an appropriation of $36,000 for cooperation with the State Plant Board of Florida on the eradication and control of the West Indian fruitfly and the citrus blackfly. The State plant board has continued its work on the West Indian fruitfly and the citrus blackfly, the Bureau cooperating in both these activities. The work on the citrus blackfly conducted on the island of Key West had previously been carried on solely with funds provided by the State. These activities involved spraying of various host trees to eradicate the infestation of the blackfly, which was recently discovered on this island. Opposition on the part of residents to spraying operations hampered the work and for a while spraying was discontinued. During the latter part of the year the courts rendered decisions favorable for continuing the work, and the eradication activities were resumed, but since then the expenses of operation have been supported by State funds.

The active work to eradicate the two forms of the West Indian fruitfly known to occur in Key West was continued during the summer and early fall, in cooperation with the State plant board. This included the clean-up of host fruits, the spraying of host trees with sweetened poison, and the operation of traps containing attractants. Some trapping was also carried on in other southern parts of the State, and early in the winter of 1935 adult specimens of both forms of the West Indian fruitfly were collected in traps in a number of locations in the southern part of Florida. Following this, trapping operations on the mainland were intensified and revealed the presence of fruitflies in some 20 different localities. The discovery of the presence of adult fruitflies in various locations on the mainland led to the revocation, by the State

plant board, of the quarantine they had maintained on Key West on account of the presence of the West Indian fruitflies. Trapping and scouting work to locate the possible presence of fruitflies on the mainland, with the idea of securing information as to their current status and distribution, was carried on intensively during the latter part of the fiscal year, the expenses incident to this work being met by the State. No authentic larval infestations have been discovered at any point on the mainland, and during the last few months of the fiscal year no specimens of adult fruitflies were taken in traps. In addition to the finding of two forms of the West Indian fruitfly at various locations in the southern part of Florida, scouting and trapping operations disclosed the presence of two other related fruitflies. These appear to represent undescribed species concerning which little is known. While their field hosts have not been determined, available information suggests that they do not attack fleshy fruits of commercial value.

JAPANESE BEETLE QUARANTINE AND CONTROL

TRAP SCOUTING IN NONREGULATED TERRITORY

Trap scouting for the Japanese beetle (*Popillia japonica* Newm.) was carried on during the summer of 1935 in 213 towns and cities in 13 States. Approximately 58,000 traps were set, nearly double the number employed in the previous year's annual survey of nonregulated territory. Japanese beetles were captured in 120 communities. The results of trapping in 1935 disclosed 34 small, first-record infestations, 8 of which were in North Carolina, 11 in Virginia, 1 each in Maryland and Maine, 4 in West Virginia, and 9 in Ohio. With the exception of the first-record infestations at Marietta, Ohio, Pulaski, Va., Chester and Parkersburg, W. Va., and certain suburban areas adjacent to the infestation in Richmond, Va., all these initial finds were of fewer than 10 beetles each. Trapping in 94 cities and towns gave negative results. Finds in St. Louis, Chicago, and Indianapolis are outside a 500-mile radius from the center of infestation. All other points at which catches were made are within that radius.

In Greenville, S. C., from collections of a single beetle in 1933 and 2 beetles in 1934, collections during the summer of 1935 jumped to 89 in 4 times the number of traps set the previous year. Beetles did not reappear in Charleston and Florence, S. C., where soil treatments were made after the discovery of a few beetles in each locality prior to 1934.

Control measures thus far applied in St. Louis, Mo., are definitely promising. Over 10,000 traps were operated throughout the city from May 10 to September 2, 1935. Traps concentrated in areas where 1,351 beetles were caught in 1934 were able to catch only 904 beetles, a reduction of one-third. Total catches in the city were 125 under those of 1934.

There was a threefold increase in the number of beetles trapped in Indianapolis. In 1934, the first year traps were used in that city, 17 beetles were caught. In 1935, with over three times the number of traps in operation, 57 beetles were collected.

In Chicago 6 beetles were caught in slightly over 1,000 traps in 1934, and in 1935 39 beetles were collected in over 3,000 traps. Of this total, 23 beetles were collected in the immediate vicinity of the Chicago Produce Terminal, and 9 additional beetles were caught in nearby sections. Of the remaining five trap catches, two were made in a residential district 6 miles from the produce terminal and three in another residential section 7 miles from the main area.

Starting with 1932, there have been annual catches in Detroit of 8, 4, 10, and, in 1935, 23 beetles. All but two of those caught in 1935 were trapped in the general locality of the Michigan Central Railroad depot and the New York Central right-of-way. Other than two catches of two beetles each, all Detroit finds were of single beetles on scattered premises.

First-record infestations, most of them of one or two beetles each, were found in Ohio at Akron, Chillicothe, Conneaut, Hills and Dales Village, Lancaster, Marietta, Salem, Toledo, and Wooster. Previously discovered infestations, which have fluctuated in quantities collected within a range of from 1 to 24 beetles, recurred at Canton, Cleveland, East Liverpool, Steubenville, Youngstown, and Zanesville. The Columbus infestation showed a pronounced increase in 1935, with 92 beetles found over an area of approximately 12 square miles.

Trapping in West Virginia was carried on during 1935 in 19 cities and towns, with resulting captures in 9 localities. Beetles were trapped for the first time

in Chester, Huntington, Moundsville, and Parkersburg. Recurring infestations at Clarksburg, Fairmont, Martinsburg, and Wheeling increased in number of beetles trapped, and the new infestations determined at Chester and Parkersburg involved finds of a fair number of insects. There was a general increase in the number of traps used in West Virginia.

Trapping in Virginia in 1935 extended to 37 towns and cities, with resulting catches in 24 localities. These included first-record catches at 11 points, the most important of which were in suburban sections of Richmond.

Traps set in 39 North Carolina communities revealed infestations in 16 cities. The largest infestation in the State was disclosed at Winston-Salem, where a few beetles had been collected in both 1932 and 1933.

With the single exception of a one-beetle find at Emmitsburg, the Maryland infestations were found where beetles had been discovered in previous years. A number of the localities were first found infested as long ago as 1932.

There was a further progressive decrease in the number of beetles that could be collected in Erie, Pa. Since 1932, when 282 beetles were caught, trapping in successive years has netted 167, 114, and, in 1935, 73 beetles.

Trapping in New York was carried on in 14 cities, with beetle captures recorded in 6 localities where infestations had been determined in previous years.

In the nonregulated section of Maine, increases were noted in the infestations at Auburn, Gorham, and Lewiston.

Early-season trapping activities in 1936 began with the placement of traps in St. Louis, Mo., on May 4. Southern trapping began in South Carolina with the distribution of traps in 11 cities throughout the State between May 26 and June 11. Trap setting was completed in Athens, Augusta, and Savannah, Ga., between May 29 and June 10.

By the end of the year additional traps were in operation in 4 cities and towns in Illinois, 6 cities in Indiana, 4 localities in Kentucky, 57 nonregulated communities in Maryland, 3 other cities in Missouri, 27 North Carolina towns and cities, 10 Ohio communities, 4 Tennessee cities, 65 cities and towns in Virginia, and at 3 points in West Virginia. For the purpose of checking an apparently erroneous report of the finding of a single Japanese beetle on the farm of the Kansas State College at Manhattan, Kans., traps were operated during June at that point with negative results. The earliest beetle catch in the season of 1936 was made at Charleston, S. C., on May 30.

Trap captures recorded during May and June included a single beetle in Savannah, Ga.; 23 beetles in St. Louis, Mo.; 2 beetles in Bristol, Tenn.; small captures at 10 points in North Carolina; 15 and 11 beetles, respectively, in Greenville and Charleston, S. C.; 2 beetles in Bon Air, Va.; and 1 beetle at Marietta, Ohio. Finds at Savannah, Ga., Wilson, N. C., and Bristol, Tenn., were first records; the others were survivals of previously determined infestations.

SUPPRESSIVE MEASURES

Application of lead arsenate to two new Japanese beetle infestations in St. Louis, Mo., began on August 8, 1935, and was completed on October 8. From September 27 until completion of the work the spraying was performed with State-supplied labor. Approximately 100 acres were sprayed at the rate of 1,000 pounds of lead arsenate per acre.

Similar applications of lead arsenate were made between October 9 and 24 to the soil in newly discovered infested sections of Indianapolis, Ind., outside of the section treated in 1934. Two federally owned sprayers were shipped to Indianapolis from the central Pennsylvania warehouse, and the two sprayers that had been in St. Louis were driven to Indianapolis. In addition to an extension of the area treated in 1934, two isolated sections were sprayed. Approximately 20 tons of State-purchased lead arsenate were applied at the rate of 1,000 pounds per acre. Labor for the Indianapolis project was paid from relief funds.

Several light snowfalls interrupted soil treatments applied in Erie, Pa., from April 13 to 24, 1936. Two federally owned tank sprayers were provided to apply the State-purchased lead arsenate. Hosemen and other laborers were also provided by the Pennsylvania Department of Agriculture. Four tons of lead arsenate were sprayed on 8 acres of ground in sections of Erie outside of previously poisoned areas where Japanese beetles were trapped in 1935.

Treating operations began in Detroit, Mich, on April 30. A Works Progress Administration conservation project in Detroit provided funds for the pur-

chase of 18 tons of lead arsenate, for the necessary labor to apply the insecticide, and for the rental of spray trucks used to supplement those owned by the city of Detroit. At the height of the work as many as 14 sprayers were in use and 76 laborers were employed. The work was completed on June 3. Treatments at the 1,000-pound rate extended to a total of 35.2 acres in the infested districts.

In cooperation with officials of the South Carolina State Crop Pest Commission, three employees of the division, working from April 22 to May 5, applied 8 tons of lead arsenate to 16 acres in and surrounding the sections of Greenville, S. C., where 89 beetles were caught during 1935. An appropriation of $1,600 from the State contingent fund was available for the purchase of material. Two high-pressure sprayers were driven to Greenville from the project's warehouse at New Cumberland, Pa.

Following the quarantine hearing in November, the Ohio Department of Agriculture and Conservation obtained an emergency appropriation of $32,500 from the Ohio Board of Control for treatment of approximately 250 acres in Ohio cities and towns where Japanese beetle infestations were found during 1935. The funds were made available too late to apply the lead arsenate effectively before freezing weather. Had the treating plans been carried out, the insecticide would have been applied in the spring of 1936. The number of traps scattered throughout Ohio during 1935 were not sufficient to delimit the infested sections in the several communities where apparently established infestations were found to exist. In the absence of definite information on the limits of each area, it did not appear practicable to treat the known infested sections, because of the likelihood that intensive trapping during 1936 would considerably extend the zones requiring soil poisoning to suppress the larval population. Accordingly, the Ohio treatments were deferred pending the results of another season's trapping.

Approval was received during March by the Missouri Department of Agriculture of a State Works Progress Administration project for combined lead arsenate treatment and intensive trapping of the infested sections of St. Louis. A balance of an original allotment of $5,000 by the city of St. Louis was also available during the year. Lead arsenate applications were begun on June 29.

FEDERAL AND STATE REGULATORY MEASURES

Seventy-five nurserymen, nursery association representatives, and State officials from 23 States and the District of Columbia attended a public hearing held in Washington, D. C., on November 16, 1935, to consider the advisability of revoking the Japanese beetle quarantine or extending it to the States of Illinois, Indiana, Michigan, Missouri, Ohio, North Carolina, and South Carolina. Testimony at the hearing was almost unanimously in favor of continuance of the quarantine. Recommendations were also made that the small isolated infestations should not be included in the quarantined area but that every effort should be made to suppress these infestations.

Conferences and exchanges of correspondence with officials in nonregulated States concerning the established infestations from which secondary spread might be expected resulted in the adoption of several different plans to prevent dispersal of the insect.

Following assurances from officials of nonquarantined States containing isolated infestations that adequate measures would be taken to prevent the spread of the beetle from infestations within their borders, revised regulations were issued, effective March 16, 1936, to extend the restricted zone to cover important infestations determined by traps set in Lewiston, Gorham, and Auburn, Maine; Ithaca, N. Y.; a series of communities in Loudoun, Fauquier, and Culpeper Counties, and suburban areas contiguous to Richmond, Va.; and a scattering of Maryland localities in Carroll, Howard, Caroline, Prince Georges, and Charles Counties.

Supplementary intrastate quarantines issued by the States of Maryland, New York, Virginia, and West Virginia placed under regulation the newly federally regulated area in each State, together with isolated infestations at Hurlock and Frederick, Md.; Buffalo, N. Y.; Charlottesville, Roanoke, and Salem, Va.; and Chester, Clarksburg, Fairmont, and Parkersburg, W. Va.

Satisfactory treating programs in Detroit, Mich., Greenville, S. C., Erie, Pa., St. Louis, Mo., and Indianapolis, Ind., adequately protected noninfested sections from secondary dissemination of the pest from these detached points.

Missouri and Indiana intrastate quarantines embracing actually infested blocks supplemented the treating activities in St. Louis and Indianapolis.

Some of the States in which remote, apparently established infestations were disclosed selected quarantine action in lieu of soil treatment. Intrastate quarantines were accordingly issued by Illinois and North Carolina. The quarantined zone in Illinois circumscribes the actually infested blocks in Chicago. The North Carolina regulations are applicable to three separate areas surrounding, respectively, Winston-Salem, Spencer and Salisbury, and Greensboro. A similar intrastate quarantine was prepared by Ohio agricultural officials to place under regulation Cleveland, Columbus, Canton and its suburb Hills and Dales, Marietta, Steubenville, and Youngstown. In some instances quarantine action was preferable, since the 1935 trapping was not extensive enough to delimit the infestation in certain localities. Trapping over a wider area will be necessary in order to determine the scope of the indefinite infestations and the practicability of soil treatment to suppress the larval population.

HIGHWAY INSPECTION SERVICE

With trafficking in quarantined products at a peak during July, road-patrol activities were at their maximum during that month. Twenty-nine posts that had been in operation since April and May of the previous year were supplemented in July by six added stations in Virginia and along the Pennsylvania-Ohio line. When fall movement of nursery stock was at its height, 64 road inspectors were required for effective operation of the posts.

On July 1 eight New York State inspectors were instructed in quarantine-line operation and six of them were assigned to three permanent stations, operating 16 hours a day, at Corning, Elbridge, and Lake George. Two roving inspectors with cars were assigned to patrol roads not covered by regular posts in the stretch from Cortland to Johnstown. These posts were continued until September 14.

Closing of the regular stations began late in September, and gradual abandonment of the posts continued during October and November. By the end of November the only remaining stations were those on United States routes 1 and 17, south of Fredericksburg, Va. Inasmuch as a small volume of nursery and greenhouse material continued to move southward even during the severe weather, two inspectors were kept at each of these posts and the stations operated 16 hours per day throughout the winter. During the freezing weather of January and February, 70 interceptions of contraband material were made at these stations. This is the first season that year-round stations have been operated on the boundary of the regulated territory.

Expansion of the road-patrol activities in the spring of 1936 began with the addition, on March 25 and 26, of five road stations to handle southbound traffic from the enlarged Virginia regulated zone. Destruction of the bridges over the Potomac River at Harpers Ferry and Shepherdstown, W. Va., by the March flood eliminated two exit highways that previously had required guarding. Realinement of the Virginia area added one additional highway to the number of posts previously patrolled in that State. Establishment of posts on the West Virginia-Maryland and Pennsylvania-West Virginia-Ohio State lines began on April 2. Fourteen posts were set up between April 2 and 29, most of them with one inspector each, operating 8 hours per day.

Posting of the most important highways was concluded early in May with the addition of two stations in Virginia and the assignment of Pennsylvania State inspectors to guard four highways on the Pennsylvania intrastate boundary. When the seasonal restrictions on fruits and vegetables became operative on June 15, two additional stations in Virginia and one in West Virginia were opened. Inspection personnel was increased during June and full quotas of men were assigned to the posts by June 30.

At the end of the year there were in operation 31 road stations, 12 of which were in Virginia, 5 in West Virginia, 5 on the Pennsylvania State line, and 9 in northwestern Pennsylvania. A maximum of 41 inspectors were engaged in road inspection during the spring season.

Trucks returning empty to southern points after driving through sections in which the beetles were swarming were frequently found to contain large numbers of adults. Among the empty trucks cleaned during July and August, 99 were infested with a total of 2,223 adults, approximately one-third of which were sufficiently vigorous to survive until the arrival of the trucks at destina-

tions in noninfested States. As many as 260 adults were swept from a single truck. Another truck contained 222 beetles. Quantities ranging from 75 to 198 beetles were removed from eight other trucks. Forty-eight lots of infested plant material were intercepted at the posts, and 145 Japanese beetle grubs were removed from soil accompanying these plants. Counts of all moter vehicles stopped for inspection at the road stations during the year totaled 3,603,796. Uncertified quarantined products were found in 20,974 vehicles.

Major interceptions reported by the road inspectors and confirmed by identification of specimens at field headquarters included 40 live adults removed from a truckload of onions and cabbage en route from Philadelphia, Pa., to Dannemora, N. Y.; 17 grubs found in two rose bushes in the possession of a motorist proceeding from Wilmington, Del., to New Bern, N. C.; and 25 larvae found in 20 bags of soil and the soil balls around the roots of 20 cedar trees en route via truck from Toms River, N. J., to Daytona, Fla.

CERTIFICATION AND TREATMENT OF NURSERY STOCK

Field inspections during the summer of 1935 showed pronounced increases in the extent and intensity of infestation in sections with continuous, heavy beetle populations. This was particularly apparent in the metropolitan area of New York City. On Long Island and counties north of Manhattan, infestations were found for the first time in or near 40 classified nurseries and greenhouses. Foliage damage from beetle feeding was noticeable on Governors Island in New York Harbor. Scouting in northern New Jersey disclosed infestations in most of the classified establishments that previously had been free from the pest. Definite increases were noted in the known infestations in a few south-central Pennsylvania counties. Millions of beetles again flew oceanward from the New Jersey area and were washed in with the tides to form windrows along the New Jersey and Long Island beaches.

Many new infestations were found during 1935 in nursery and greenhouse premises in Lancaster, York, Berks, and Dauphin Counties, Pa., and in Maryland, Virginia, and northern New Jersey. In New England beetles were found on the premises of nine nurseries in Connecticut and on four classified establishments in Massachusetts. One classified nursery in New Hampshire was found infested. The last of the nursery and greenhouse scouts were dismissed on September 14.

Supplemental instructions issued August 23, 1935, authorized for the first time the fumigation of certain varieties of azaleas that theretofore had to be grown under beetle-proof conditions in order to be eligible for certification. The fumigation is accomplished by removing the azaleas from the pots, or burlap from field-grown stock, and plunging the moist plant balls in soil mixed with paradichlorobenzene at rates of 10 to 20 pounds per cubic yard, dependent upon the size of the soil ball or potted plant to be fumigated. A fumigation period of 5 days is prescribed. This treatment is authorized between October 1 and May 1.

Fall shipments of nursery stock began in September. Inspection demands during the fall shipping season were about normal. Additional temporary inspectors were required to handle the work from the first of November until the ground froze. In many instances nursery stock moved in carload lots, in contrast to the small shipments of the past few years.

Prolonged cold weather in the entire area lasting through February prevented stock being dug to fill early orders. Volume shipments did not start until late in March. With the arrival of typical spring weather toward the latter part of March, nurserymen were forced to speed their shipments to the limit. Seasonal trade among the nurseries and greenhouses was exceptionally good at Christmas, Easter, Mother's Day, and Memorial Day. Numerous shortages of stock were reported.

A decided improvement in the nursery trade over the last few years was reflected in increased spring inspection demands which had to be met with the usual number of inspectors. Calls for inspection were received from shippers that had been more or less inactive during the last few years. Several new establishments applied for a classified status. Movements of nursery stock were largely completed by Memorial Day. Nurserymen were almost unanimous in reporting larger sales of stock than in the spring of 1935.

By the end of May over 1,000 samples had been collected from 66.1 acres of nursery plots, heeling-in areas, and frames treated with lead arsenate. Results of analyses were soon available from the research laboratory, and applications

of lead arsenate to the areas showing deficiencies of the poison were completed by June 30. Initial applications of lead arsenate were also made to 11.7 acres of nursery plots and heeling-in sections.

Lists of classified nurseries and greenhouses were revised and redistributed to the trade in March. A new edition of the shipper's guide, enlarged to contain the cities and towns added to the regulated area with the revision of the regulations effective March 16, 1936, was distributed in June. Similar distribution was made of a newly printed map poster showing the regulated areas.

Commercial establishments conforming to the requirements for classification increased from 2,241 to 2,271. Divided on a basis of classification, 1,636 of these establishments were in class I, 618 in class III, and 17 in an intermediary classification with portions in each status. There was a net increase of 77 in the number of infested establishments, and a net decrease of 48 in the number of uninfested classified nurseries.

Following transfer of the field headquarters from White Plains, N. Y., to Bloomfield, N. J., the Japanese beetle suboffice at Rutherford, N. J., was combined with the field headquarters.

Initial reports of adult Japanese beetle emergence in 1936 were received from Philadelphia on June 2 and from Glassboro, N. J., on June 9.

CERTIFICATION OF FRUITS, VEGETABLES, AND CUT FLOWERS

Following organization of the inspection force on a summer basis just prior to the beginning of the fiscal year, over 100 temporarily employed farm-products inspectors were added to the personnel to meet the demands for inspection of commodities requiring 100-percent inspection during the period of flight of adult beetles. Inspection centers were established at 36 points throughout the regulated area. Special platforms were erected or rented at Fredericksburg and Exmore, Va.; Washington, D. C.; Baltimore, Cumberland, and Hagerstown, Md.; Wilmington and Wyoming, Del.; Philadelphia and Pittsburgh, Pa.; Camden, N. J.; and Syracuse and Menands, N. Y. Complete inspection of all farm products offered for inspection began on July 3, when beetles began to emerge in large numbers. Inspection of cut flowers at wholesale houses required the assignment of special inspectors to that activity in Richmond, Baltimore, Philadelphia, New York City, and Boston.

Hampers of beans constituted one of the largest items among the commodities inspected in New Jersey, eastern Pennsylvania, Maryland, Delaware, and Virginia.

With the concentration at Fredericksburg, Va., of inspection of all southbound products moving via truck, it was necessary to employ 15 inspectors and to use four mechanical bean-inspecting machines to take care of trucks starting from or driving through the heavily infested territory.

Revival of carlot and truck shipments of berries from the Hammonton, N. J., area occasioned the overhauling and reopening of the fumigation house at that point. During the summer of 1934 the berry market did not justify the use of the house. Fumigation of blueberries in the grower-owned fumigation house at New Lisbon, N. J., started July 4 and continued until the crop was marketed. There was an abundant crop of berries from these two sections, large quantities of which moved under certification.

Certification requirements applicable to a limited number of farm products from the entire regulated territory and on shipments of fruits and vegetables of all kinds moving via refrigerator car or motor truck from certain heavily infested sections of the area continued in effect. The revised regulations extended the zone from which refrigerator and truck movements of produce were regulated to include the entire State of Delaware rather than a single county as theretofore.

Adult beetle flight in the vicinity of New Jersey spur tracks where potatoes and onions were being loaded became so heavy by July 8 that fumigation of the cars was required. Fumigation of these commodities, as well as bananas loaded at Philadelphia and Baltimore, continued until late in August. Most of the cars containing onions and potatoes were fumigated at night. Hydrocyanic acid fumigant was sprayed in the cars at the loading point, after which the cars were sealed and then shifted into a central yard where the hatches were opened and screened and the cars certified.

While the adult beetles were in active flight and swarming about many of the New Jersey railroad sidings where farm commodities were being loaded, the

services of the transit inspector and trap supervisor stationed in Chicago were utilized to examine cars of produce arriving at that point from the regulated area. A total of 258 refrigerator cars and 65 ventilated boxcars moving from the densely infested sections were examined and 238 dead and 8 live beetles were found.

By screening the Philadelphia inspection platform and carrying out the new regulations respecting cleaning and fumigation, it was possible to carry on the regular schedule of inspection without the customary limiting of inspection hours to those during which the beetle was inactive. Although adult beetles were later in emerging in Philadelphia than usual, when they did appear it was in great numbers. They were more numerous in the central part of the city than in 1934. The waterfront district in Camden, N. J., was badly infested, resulting in many beetles swarming around the dock and Callowhill markets in Philadelphia. The parks and public squares nearest the market and wharf district showed a decided increase in infestation. Crew members on ships arriving at Philadelphia and Chester stated that beetles flew aboard ship lower in the Delaware River than at any time during the summer of 1934.

With the revocation on and after September 18 of the seasonal quarantine restrictions on fruits and vegetables, the temporary inspection force was dismissed. Although scattered beetles were still found in the generally infested area, they were not in flight and had not been found infesting farm products for some time prior to the lifting of the regulations. As beetles were still to be found in blooms of outdoor-grown flowers, the restrictions on the movement of cut flowers were continued in effect until the latest date, October 15.

In the course of the seasonal quarantine on fruits, vegetables, and cut flowers, inspectors removed 3,666 adult beetles from commodities certified for transportation to uninfested States. Cut flowers, beans, cabbages, corn, apples, potatoes, and cucumbers were the articles from which the greatest numbers of beetles were removed.

CERTIFICATES ISSUED, VIOLATIONS INVESTIGATED, AND PROSECUTIONS TERMINATED

A total of 481,575 certificates of all kinds were required to cover quarantined products moving to nonregulated territory during the fiscal year.

Table 9 shows the quarantined articles intended for shipment from the regulated area and for use in certified greenhouses, or surface soil in nursery plots, heeling-in, or plunging areas, which were fumigated or sterilized during the 12-month period.

TABLE 9.—*Materials fumigated or sterilized under Japanese beetle quarantine regulations, fiscal year 1936*

Treatment	Plants	Potting soil	Mushroom soil	Leafmold	Sand	Surface soil
	Number	*Cubic yards*	*Cubic yards*	*Cubic yards*	*Cubic yards*	*Square feet*
Lead arsenate		50				644,571
Carbon disulphide gas or emulsion	3,046	2,016	261	26	2,559	25,011
Naphthalene		157				29,780
Steam		607				5,832
Hydrocyanic acid						
Paradichlorobenzene	56,331					

Treatment	Surface soil with plants	Berries	Bananas	Potatoes		Onions	Tomatoes
	Square feet	*Crates*	*Bunches*	*Barrels*	*Bags*	*Bags*	*Crates*
Lead arsenate	2,947,877						
Carbon disulphide gas or emulsion		4,337					
Naphthalene							
Steam							
Hydrocyanic acid			308,653	30,362	25,835	10,973	675

Nursery and ornamental stock, sand, soil, earth, peat, compost, and manure were certified for shipment from the regulated areas during the fiscal year in the following quantities:

Plants	number	28,532,867
Sand, earth, and clay	carloads	6,681
Peat	do	60
Manure and compost	do	243

Fruits, vegetables, moss, and cut flowers certified during the seasonal quarantine on these articles were as follows:

Fruits and vegetables	packages	4,877,241
Moss	bales	1,299
Cut flowers	packages	29,861

Investigations were made of 1,317 apparent violations of the Japanese beetle quarantine regulations. These included interceptions by transit inspectors of the Bureau stationed at postal and common-carrier terminals and by highway inspectors examining road vehicles. Conviction was secured in the case of a trucker who transported uncertified farm products from Washington, D. C., to Manassas, Va. Prosecution was pending at the end of the fiscal year against a firm that shipped plant material from New York, N. Y., to Miami, Fla.

COOPERATIVE ENTERPRISES

State funds for cooperative control or quarantine activities were again available in Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia.

Traps to suppress established beetle populations were operated during the summer of 1935 by the States of Connecticut, Delaware, Maryland, Massachusetts, and Rhode Island.

In Illinois, Indiana, and Maine practically all trap labor was paid from State funds. Relief organizations furnished most of the trap labor in Detroit, North Carolina, South Carolina, Pennsylvania, Virginia, and West Virginia, one-fourth of the trap labor in Ohio, and carried the trap activities in St. Louis through the first week in August. Altogether the equivalent of approximately $23,000 in labor was provided by various welfare organizations. In addition, State, city, and relief officials provided the trucks and drivers necessary to set and remove traps in Illinois, Indiana, Maine, Michigan, Missouri, and Pennsylvania.

Under an agreement with the New Jersey Department of Agriculture, the Bureau will cooperate with the State laboratory located at the White Horse Japanese beetle quarantine headquarters in experiments to determine the effectiveness of the nematode *Neoaplactana glaseri* in eradicating established infestations of the Japanese beetle. The cooperative arrangements call for equal financial contributions from Federal and State departments for this investigational work.

PHONY PEACH DISEASE CONTROL

Activities of the Department in the control of the phony peach disease, conducted in cooperation with the affected States during the last 7 years, have resulted in reducing the disease in the heavily infected areas from approximately 18 percent in 1929 to less than 2 percent in 1935. The peach industry in this area, which was in a demoralized condition a few years ago, owing primarily to the heavy losses resulting from this disease, is now being revived and expanded. Growers in the heavily infected areas still recognize the seriousness of this disease, but they no longer feel that it marks the end of profitable peach production.

At the beginning of the year phony peach disease was known to be heavy in Georgia and Alabama, general in all other Gulf Coast States west through Texas, and light and spotted in North Carolina, South Carolina, Tennessee, Arkansas, Missouri, Illinois, and Oklahoma. In view of the slowness of the natural spread of this disease and the apparent success of control measures, it seems evident that early economic control and eventual eradication are entirely possible even in the heavily infected areas, provided the shipping of infected nursery stock is prevented. Control measures of the year were therefore directed toward (1) the inspection and removal of diseased trees from the environs of nurseries

growing peach stock throughout the infected States, (2) the inspection of orchards throughout the commercial peach belt, (3) a survey beyond the limits of known distribution of the disease for the purpose of locating any previously undiscovered outlying infections, and (4) the eradication, through State cooperation, of diseased trees throughout the infected area.

The environs of 113 nurseries in 12 infected States were inspected in the field season of 1935, and 26 were found exposed to the phony peach disease. In 1936 the environs of 228 nurseries in 9 infected States have been inspected thus far (to the close of June), and 54 nurseries have been found exposed to infection. Eradication of the diseased trees was effected at the time of inspection or the trees were tagged for destruction by eradication crews. Other activities in the fiscal year 1936 covered the inspection of approximately 19,000,000 peach trees in nearly 66,000 orchards in 14 States. Of these trees over 51,000 were found infected and are being destroyed under State authority.

In the summer of 1935 the most intensive survey of recent years was carried on in peach-growing districts of Delaware, New Jersey, Maryland, Virginia, West Virginia, Kentucky, and Indiana, with the result that phony peach disease was found in orchards in two counties in Maryland and in five counties in Kentucky. Similar intensive work in States known to be lightly infected resulted in finding the disease in new areas in such States. This survey was expanded in 1936, and it is expected that the corps of 153 trained Federal and State inspectors will survey all States north of the known infected areas in which there is commercial peach production. The work in Iowa, Nebraska, and Kansas was accomplished by a combined survey for the peach mosaic and phony peach diseases. No phony trees were found.

One of the problems in the campaign the Department has conducted against the phony peach disease has been the presence of abandoned, escaped, and seedling peach trees, which grow in enormous numbers throughout the South and which serve as reservoirs of reinfection. The removal of such worthless trees, a work outside the scope of regular Federal activities and available funds, is now being accomplished under an allotment from the Emergency Relief Appropriation Act of 1935, and as a supplement to inspection is proving to be an important factor in freeing the peach-producing States of this destructive disease. From the beginning of this project in August 1935 to the close of June 1936 over 38 million worthless peach trees on nearly 76,000 properties were destroyed in 11 States. The work provided employment throughout the year for approximately 2,000 men.

CONTROL OF PEACH MOSAIC DISEASE

Peach mosaic, a virus disease of peach trees, was first observed in Texas in 1931. In 1934 it was reported to be present in the commercial peach belt of Mesa County, Colo., where it had apparently been present for several years.

The agency of natural spread of this disease is unknown. It is infectious and may be transmitted by patch-bark grafting from either twig or root bark. Indications are that the incubation period is less than 12 months. The natural spread is generally in colony formation. The appalling rapidity of spread is evidenced by the records of one orchard of over 1,200 trees in Mesa County, Colo., which showed 2 infected trees in 1929, approximately 10 in 1931, 100 in 1932, 200 in 1933, and 500 in 1934, and all except 13 were infected in 1935.

In the spring of 1935 the State of Colorado undertook an intensive eradication campaign which was supplemented in August of that year by a Federal relief-work project.

The project for control of the peach mosaic disease (eradication and survey), which was carried on under an allotment from the Emergency Relief Appropriation Act of 1935, consisted of intensive inspection of all peach trees in Mesa and Delta Counties, Colo., to locate and remove all trees infected with this very destructive disease; survey for the disease in all other counties in Colorado where peach trees were grown; surveys in Iowa, Kansas, and Nebraska, to determine the possible occurrence of peach mosaic; and an extensive survey in Texas to determine the prevalence and extent of the disease in that State. These activities were carried on in cooperation with the respective States.

During the year nearly 3,000,000 peach trees were inspected and 13,788 mosaic-diseased trees in Colorado and Texas and 17,456 abandoned trees in Colorado were removed and destroyed under State authority.

Eradication of the peach mosaic disease is necessary from a commercial standpoint. The results of the year's work in the infected area in Colorado have proved conclusively that an eradication program is practicable.

Peach mosaic disease has recently been found in California, New Mexico, and Utah, and during 1937 survey and eradication activities will be extended to those States and to Arizona and will be continued in Colorado and Texas to the extent possible under a $25,000 allotment from the Emergency Relief Appropriation Act of 1936.

CITRUS CANKER ERADICATION

Federal and State activities directed toward the eradication of citrus canker have been in progress for over 20 years. Eradication of this disease was apparently accomplished prior to 1928 in all the Gulf coast area except a noncommercial district in Texas and Louisiana; most of the work incident to this undertaking has, therefore, long since been completed. However, the very difficult task of destroying the last vestige of this disease in the United States, which marks the vast difference between eradication and effective control, still remains to be accomplished.

The area now known to be infected is that in which Satsuma orange production was undertaken on an extensive scale 20 to 25 years ago, but in which, owing to the ravages of citrus canker and to severe winter-kill, the enterprise was abandoned as a commercial industry. However, the cold-resistant *Citrus trifoliata* root stock has not only survived but has become naturalized, and infected plants are now being found intermingled with other vegetation long distances from original plantings. Eradication is, therefore, very difficult and necessitates thorough, intensive, and systematic inspection under adverse conditions.

Citrus canker inspection was placed on an intensive basis about the first of the year 1935, and in a period of 6 months the disease was located on 31 properties in the Galveston-Houston district of Texas. In the fiscal year 1936, under the campaign of inspection and eradication, the number of infected properties found in the district was reduced to six. Inspection in outlying counties brought to light an infection center of some years' duration at Beaumont and a few cases in Harris County. Recently, under an expanded program, inspection was extended to a number of southerly counties, with special attention to properties on which the disease was found in earlier years. No canker, however, has been located south of Brazoria County in this recent inspection. During this 18 months' campaign 23 counties have been worked, 4 of which showed canker-infected properties. All infected properties have been reinspected again and again for any sign of recurring infection.

In southern Louisiana all the area from the Mississippi River west for approximately 100 miles was inspected during the year for citrus canker. The remaining citrus area, west to the Texas border at Orange, is now being worked intensively, as is the case with respect to an important area east of the Mississippi along the north shore of Lake Pontchartrain. Eight infected properties were found during the year in the parishes of Terrebonne, St. Charles, Lafourche, and Calcasieu.

The problem of surveying the citrus growth in the marsh areas of Louisiana was recently solved by the use of an autogiro. Moats on which citrus exists were located and mapped on air-photo compilations supplied by the Coast and Geodetic Survey. This method of systematically flying over the areas made possible the discovery of 24 heretofore unknown locations of citrus growth and proved an ideal way to survey the swamp areas. Ground inspection of these trees is now under way.

Under an allotment from the Emergency Relief Appropriation Act of 1935, more than 8,000,000 abandoned and escaped citrus trees were destroyed by relief labor in Texas and Louisiana. Of these trees, 1,613 were infected by the citrus canker disease. The work provided 378,171 man-hours of employment during the year.

DATE SCALE ERADICATION

A final inspection was given the plantings in the date-growing districts not previously dropped as free from parlatoria date scale. Prior to this the pruning necessary to facilitate inspection had been done. Inspection of leaf bases, accomplished by peeling the trunks, permitted careful examination of palms on

which infestation had been found in previous years and gave added assurance of freedom from infestation. During the past several years a section-by-section survey to locate unlisted palms had been carried on to guard against the possibility that such trees might be missed by the inspectors and thus enable the date scale to carry over. This scouting for unlisted palms was completed. During the past several years intensive inspections at appropriate intervals were made to detect infestations as promptly as possible so as to prevent infested trees from serving as centers of spread. As circumstances warranted, the intervals between these inspections were increased, the program was broadened by intensive leaf-base inspections and finally by the unlisted-palm scouting, and the completion of these activities, together with the passage of a substantial period without finding any infestation, leads to the decision that this completes the Federal-State date scale eradication project.

COACHELLA VALLEY

During the year 33,434 palm inspections were made from the ground only, 3,097 palm inspections were made from ground and ladders, and 943 offshoots were certified for movement. Leaf bases were removed from 61 previously infested palms, and 59 valueless palms were dug out and destroyed. A total of 84¼ sections were scouted for unlisted palms and 114 properties in this valley rechecked. This is the fourth consecutive year that no parlatoria date scale has been found in the Coachella Valley.

IMPERIAL VALLEY

In the Imperial Valley intensive inspection was continued in the Reed Garden, the only planting in which scale has been found since the fiscal year 1933. The final inspection of the garden was made in April 1936. No scale has been found since February 1934.

At the close of the fiscal year 1935 a considerable number of properties in the Imperial Valley were dropped from the inspection lists. Inspection was continued in the remainder. All plantings too bushy for careful inspection were pruned. Leaf bases were inspected and removed from all previously infested palms where necessary. Infested properties were checked for volunteer palms. A final scouting and inspection of palms other than date in the infested area was made.

A total of 11,857 palm inspections were made, 463 palms were pruned to facilitate inspection, and leaf bases were removed from 59 previously infested palms.

ARIZONA

In the vicinity of Yuma 3,596 palm inspections were made, completing the Federal-State project in Arizona.

A summary of date-scale activities is given in table 10.

TABLE 10.—*Summary of date scale activities, fiscal year 1936*

	Arizona	California		Total
	Yuma district	Coachella Valley district	Imperial Valley district	
Palms inspected from ground and ladders	----------	2,228	3,969	6,197
Palms inspected from ground only	3,596	33,434	6,710	43,740
Offshoots inspected for movement	----------	943	36	979
Palms pruned to facilitate inspection	----------	----------	463	463
Palms leaf-base inspected	----------	61	59	120
Palms dug out and destroyed	----------	59	----------	59
Sections scouted for unlisted palms	----------	84¼	----------	84¼
Properties checked for volunteers	----------	114	86	200
Palms other than date palms inspected	----------	869	1,178	2,047

INSECTS AFFECTING FOREST AND SHADE TREES

COOPERATIVE SERVICE

As in previous years, one of the most important activities of the Division of Forest Insect Investigations has been the cooperative service extended to the several Federal organizations administering timbered lands, such as the Forest Service, National Park Service, and Bureau of Indian Affairs, as well as to such emergency agencies as the Civilian Conservation Corps and the shelterbelt program, although advice to private timber owners has also been given. For the most part this cooperative service has consisted in surveys of forest-insect infestations, estimates of loss, recommendations as to proper control methods, estimates of the cost of such operations, and, in some cases, technical direction of control projects.

Owing to increased activity in forest conservation in connection with emergency activities, such cooperative service has greatly increased in recent years. The administration of control programs is not usually included among the duties of the Division of Forest Insect Investigations, but pertains to the administrative agencies in charge of Federal lands. However, the Division has cooperated in a technical capacity in all of the larger control operations undertaken by the Forest Service, National Park Service, and Bureau of Indian Affairs. The total of expenditures for insect-control work is not obtainable, but in the western forests alone it amounted to several hundred thousand dollars. In Forest Service region 2 alone an expenditure of $174,574.47 was made in 1936 for combating forest insects. Much of this was for control work in connection with Civilian Conservation Corps camps.

CONTROL PROGRAMS

BLACK HILLS BEETLE

As in past years, the principal control projects were undertaken against bark beetles of the genus *Dendroctonus*. Infestations by the Black Hills beetle were causing considerable damage, and more than $100,000 has been expended in their control in the central Rocky Mountain region, mostly through activities of the Civilian Conservation Corps camps. The largest of these projects were on the Medicine Bow National Forest in Wyoming and on the Uncompahgre and Montezuma National Forests in southern Colorado. The infestations in these areas have been brought under control and reduced to an endemic condition.

MOUNTAIN PINE BEETLE

In the northern Rocky Mountains no large-scale control projects were carried on during the year. The extensive control operations against the mountain pine beetle in the Coeur d'Alene which have been conducted for a number of years have resulted so successfully that no extensive work was necessary this year. While the extensive killing of trees continued in many of the lodgepole pine stands, only a few minor projects in strategic localities were undertaken by the Forest Service and Civilian Conservation Corps camps.

WESTERN PINE BEETLE

The salvage logging of beetle-killed timber was tried during the season of 1935 on a sufficiently large scale to demonstrate its low cost and practicability under certain conditions. During the recent epidemic of the western pine beetle, a considerable amount of beetle-killed timber on the Shasta, Modoc, and Lassen National Forests that would otherwise have been a total loss has been moved quickly to the mill and salvaged. During the season two lumber companies in this territory carried on operations that included the milling of 5,000,000 board feet of selected beetle-killed timber. Salvage work of this sort involves many entomological considerations, and both companies were guided in their operations by the advice of the Bureau. It was found that by moving with modern logging equipment only infested and recently killed trees, salvage was profitable where the volume taken out did not run below 400 board feet per acre. Logging costs on this basis were but slightly higher than by the regular method of cutting green timber on Forest Service sale contracts. The removal of infested trees had an appreciable effect upon the beetle population.

FOREST TENT CATERPILLAR

In the Lake States a control project against the forest tent caterpillar was carried on in Minnesota and Wisconsin. A number of powerful spraying outfits were purchased by the Forest Service and many hundreds of acres were sprayed. Particular emphasis was placed on control in recreational areas. As this work was done in June 1936, no definite report as to results is yet available.

RESEARCH ACTIVITIES

EFFECTS OF EXTREME COLD ON WESTERN BARK BEETLES

Since 1932 extreme cold has been recognized as a very important natural factor in limiting the numbers of some of our most destructive bark beetles. The degree of low temperature producing this lethal effect upon a particular species of bark beetle varies with the climatic conditions of the region from which the specimens come. Thus, in the case of the mountain pine beetle, specimens grown in the southern Sierra region do not survive a temperature of 2.5° F., whereas members of the same species growing in the northern Rocky Mountains require as low a temperature as —17° for complete mortality. Careful field studies have demonstrated that the amount of mortality can be determined with fair accuracy from records of the minimum temperatures at standard Weather Bureau stations in the areas affected. Thus it is now often possible to save thousands of dollars by discontinuing projects in bark-beetle control, already started or planned, when it is known that temperatures low enough to be fatal have occurred in the area. It is also known that the reduction in numbers is only a very temporary one if other natural factors remain favorable to the insects.

IMPROVEMENT OF BARK BEETLE CONTROL METHODS

The problem of how bark beetles can be controlled by the introduction of chemicals into the sap stream of recently infested trees seems to be approaching a practical solution. When the proper chemicals are used this method has the added advantage of preserving the wood until it can be utilized. Last season's work along this line was especially promising. More favorable results than heretofore were also obtained with a lethal oil which, when sprayed upon infested bark, will penetrate sufficiently to kill the bark beetle brood within. This spray has proved much more efficient on thin-barked lodgepole pine than on ponderosa pine. The earlier results on the thicker-barked sugar pine and ponderosa pine, although promising, were rather erratic. The development of such a method will reduce control costs materially and at the same time will eliminate the danger from fire associated with the control methods now in use.

INVESTIGATIONS IN EASTERN STATES

In the East the projects on white grubs in nurseries and plantations, the locust borer, the white-pine weevil, the southern pine beetle, and various other native and introduced forest insects have been continued. An extensive survey of the infestation by the recently introduced European spruce sawfly has shown that it is generally distributed throughout New England and New York as far west as Rochester. At no place, however, has a heavy infestation been found in this country. Several generations occur annually in southern New England, while in northern Maine one is apparently the rule.

Experiments toward development of a technique for controlling defoliating insects in forested areas by releasing poisons from an autogiro have given encouraging results. The poisons have been applied in the form of concentrated mixtures of lead arsenate, calcium arsenate, or derris in water, with fish oil as an adhesive.

VECTORS OF THE DUTCH ELM DISEASE

During the year work on known and possible vectors of the Dutch elm disease has been greatly increased. In this work, now located at Morristown, N. J., many cases of transmission have been obtained by the normal feeding of the smaller European elm bark beetle (*Scolytus multistriatus* Marsh.) upon previously healthy young elms. The native elm bark beetle (*Hylurgopinus rufipes* Eichh.) has also been shown to be a bearer of the disease, and numerous green,

previously uninfected logs have been inoculated with the disease through the brood burrows of both of these bark beetles. The disease has also been cultured from several other insects, but as yet none of these has been conclusively proved to have inoculated previously uninfected trees.

GYPSY MOTH AND BROWN-TAIL MOTH CONTROL

During the year the Federal work on the suppression and prevention of spread of the gypsy and brown-tail moths exceeded that of any previous year. In July 1935 only a small force was maintained, as the funds were limited in the regular appropriation. By the end of the month allotments were granted by the Works Progress Administration which made available for expenditure $2,800,000 for gypsy moth control work in the New England States, New York, New Jersey, and Pennsylvania and $970,000 for brown-tail moth work in the New England States. These funds were set up for a period of 14 months, but the amounts were reduced later in the year to $2,578,000 and $685,000, respectively, and the period was shortened to 11 months. One purpose of these allotments was to furnish useful work to unemployed, and more than 95 percent of the men were obtained from relief rolls through the United States Employment Service and the Works Progress Administration. The necessary supplies and equipment were obtained through the Procurement Division of the United States Treasury Department in Boston, and the auditing and disbursing was handled by the Treasury Department accounts office in that city.

The work was rapidly organized and was continued throughout the winter in spite of the fact that the weather in the States concerned was unusually severe with respect to low temperatures and the snowfall was the heaviest that had occurred for many years. Tremendous floods ravaged many sections of the area early in the spring of 1936 and caused dire suffering and unprecedented property loss. The personnel employed on these projects assisted materially in saving life and protecting property during this period.

The work was set up in each State and supervised by the existing trained personnel, who were paid from regular funds. Great credit is due the officials in the States concerned for active cooperation in furnishing additional trained men to assist in the supervisory work. These were paid from State funds, and in many cases transportation was furnished locally where Government transport was inadequate. Without this helpful assistance it would have been impossible to carry through this extensive program or to have kept the entire working force employed.

Additional gypsy moth control work was carried on in New Hampshire, Vermont, Massachusetts, and Connecticut from Civilian Conservation Corps camps east of the barrier zone, where enrollees were detailed for service under the direction of this Bureau's office at Greenfield, Mass., and in New York State, where similar work was directed by the Conservation Department. The field work was planned so that duplication of effort was avoided, although in some cases State or local work was carried on in the same counties.

GYPSY MOTH PROJECT

The allotment of Works Progress Administration funds made it possible to expand and intensify the work that had been planned in Pennsylvania and in the barrier zone in New England and eastern New York. For many years a Federal quarantine on the gypsy moth had been enforced in approximately the southern half of Maine, but there has been no opportunity, owing to lack of funds, to examine the territory skirting the northern limits of the quarantined area. Similar work was planned in a few towns in the northern part of New Hampshire and in a strip of towns in the western part of that State bordering the Connecticut River. In spite of the suppression work that had been conducted between the barrier zone and the Connecticut River in Vermont, Massachusetts, and Connecticut, there were points where the insect was developing rapidly, and the danger of the spread of infestation into the barrier zone was increased on account of heavy defoliation over extensive areas in Massachusetts directly east of the river and to a less extent in New Hampshire and in Connecticut. Intensive work was planned in the territory between the Connecticut River and the barrier zone in order to protect it from reinfestation. Territory in Connecticut east of the river was included in the plan; also Washington County, R. I., which borders Long Island Sound and Narragansett Bay and is less subject to reinfestation than any other county in that State. It was planned to carry on special

survey work in all the counties in New York State west of the Hudson River, with the exception of those in the southeastern portion that were examined during the previous year. In New Jersey scouting and check-up work, with a moderate amount of thinning, was planned in the northern part of the State, centering around an area where a small infestation was found a few years ago.

Sixty-nine high-powered Government-owned sprayers, 12 of which were purchased during the year from Works Progress Administration funds allotted to this project, were used during the spraying season. A total of 270 tons of lead arsenate was purchased with Federal funds and 70 tons were procured by the Pennsylvania Department of Agriculture for use during the spraying season. Weather conditions were favorable and excellent results from spraying were obtained.

WORK IN THE STATES CONCERNED

In Maine special scouting was carried on in the region of the quarantine line to determine whether infestation existed there. Intensive scouting, creosoting, and thinning work was also done in the southern portions of Oxford, Franklin, Somerset, and Penobscot Counties in order materially to reduce infestation in several towns near the quarantine line. Works Progress Administration workers discovered and treated infestations in 11 towns outside the quarantine line, and an additional town in Washington County was found infested early in August 1936 by regular employees on this project.

Except for a limited amount of special survey work in the northern portion of Coos County, the work in New Hampshire was chiefly confined to scouting, creosoting, selective thinning of favored food species, and burlapping in towns bordering the Connecticut River where eligible workers were available in the four western counties in that State. Three counties bordering the river, namely, Cheshire, Sullivan, and Grafton, were found to be infested, but a single infestation of 1,874 egg clusters was located and treated in the town of Lancaster. Several serious infestations discovered in Bath and Haverhill in Grafton County were thoroughly sprayed during June and the first part of July.

In Vermont, the four western counties in Massachusetts, and all counties in Connecticut except Windham, Works Progress Administration workers were engaged in scouting, creosoting, burlapping, and selective thinning of favored food species in woodland areas where infestations were found during the year. Approximately 125 men detailed from Civilian Conservation Corps camps located in Berkshire County, Mass., and Litchfield County, Conn., performed thinning work and patrolled burlap bands during July 1935. Several other infestations were located and treated in the Massachusetts and Connecticut portions of the barrier zone, and the work done east of the zone was confined principally to cleaning up and treating existing infested areas. Infestations were found and treated in the Connecticut River Valley towns in Vermont, but only one infestation was located in the Vermont portion of the barrier zone. It consisted of 133 egg clusters discovered in Essex, Chittenden County, which is approximately 25 miles south of the Canadian border. During the fall of 1935 another infestation consisting of nine egg clusters was discovered within 6 miles of the Canadian border in the town of Derby, Orleans County. As many Christmas trees are normally shipped from this town to States west of the barrier zone all areas from which they were to be cut during the fall of 1935 were scouted. No additional infestation was found in that section. These two infestations, together with several others of serious nature discovered in Orange and Windsor Counties, Vt.; Berkshire, Hampshire, and Hampden Counties, Mass.; and Litchfield, New Haven, Fairfield, and Middlesex Counties, Conn., were thoroughly sprayed during June and the first 3 days of July.

Gypsy-moth work in Rhode Island was confined to Washington County, in the extreme southwestern portion of the State, and consisted of close scouting and intensive creosoting of the infestations found. At the request of the Resettlement Administration, 14,000 acres of woodland in Federal reservations situated in this county were scouted. Six infestations were discovered and treatments applied.

In the State of New York intensive scouting was done by Federal Works Progress Administration workers with negative results in Washington, Rensselaer, and Dutchess Counties within the barrier zone and in Albany County adjacent to and west of the zone. A small force of experienced Works Progress Administration workers also performed special survey work with negative results in 17 counties, all of which are situated west of the Hudson River. A

regular employee was stationed on Long Island during the year to inspect and certify plant material moved from Nassau County. When shipping was heavy he was assisted by another experienced employee, and during slack periods he checked the scouting work performed by Civilian Conservation Corps camp personnel supervised by the New York Department of Conservation. No infestation was found in the shipments inspected or while checking Civilian Conservation Corps camp work. Employees of the New York Department of Conservation and the Civilian Conservation Corps camp force supervised by that department scouted selected areas in Washington, Rennselaer, Columbia, Dutchess and Putnam Counties within the barrier zone; Essex, Warren, Ulster, and Broome Counties west of that zone; Westchester County and the Borough of the Bronx to the south of the zone; and Queens, Nassau, and Suffolk Counties on Long Island. As a result of this work 3 infestations totaling 7 egg clusters were found in Columbia County, 16 infestations totaling 97 egg clusters in Dutchess County, 1 infestation of 6 egg clusters in Westchester County, 25 infestations totaling 127 egg clusters in the Bronx, and 24 infestations totaling 237 egg clusters in Nassau County. During the spraying season 13 acres were sprayed in Columbia County, 320 acres in Dutchess County, 30 acres in the Bronx, and 748 acres in Nassau County.

Work in New Jersey consisted of intensive scouting of selected areas in Morris, Somerset, Hunterdon, Union, and Essex Counties and selective thinning of favored-food species at sites of previously located infestations in Morris County. No infestation was discovered as a result of this work.

Ninety-five relief workers, furnished and paid by the works division of the relief boards of Lackawanna and Luzerne Counties, Pa., who assisted with the spraying during June 1935, were continued on this project until July 18 to assist in returning and cleaning spraying equipment, storing supplies, and patrolling burlap bands and destroying caterpillars found under them. The Works Progress Administration force started work about the middle of August. They performed scouting, creosoting, and burlapping work and selective thinning of favored-food species in Lackawanna, Luzerne, Carbon, Lehigh, Monroe, Pike, Wayne, and Wyoming Counties. First attention was given to scouting the lowlands along the Susquehanna and Lackawanna Rivers from Scranton to and beyond Wilkes-Barre. Only 4 infestations, aggregating 16 egg clusters, were found, and they were thoroughly treated. Spraying in residential areas in the Lackawanna and Susquehanna River valleys in Lackawanna and Luzerne Counties was started on May 20, 1936. Thirty-two high-powered sprayers were employed. Woodland spraying of the most serious infestations discovered during the year was begun on June 1 and was discontinued on July 3. Inspection and certification work in Pennsylvania increased, and 39,970 shipments were inspected during the year. This increase was due chiefly to the large amount of field stone and lumber used on local emergency-relief projects. The State of Pennsylvania allotted $60,000 for gypsy moth work during their fiscal year, which commenced on June 1, 1935, and terminated on May 31, 1936.

GYPSY MOTH WORK BY CIVILIAN CONSERVATION CORPS CAMPS

The supervision of gypsy moth work in certain Civilian Conservation Corps camps has continued. Its object was to protect the barrier zone from reinfestation and to decrease as much as possible the infestation in the area roughly bounded on the east by the Connecticut River and on the west by the zone itself. This work has increased over that of the previous year, when 18 camps were involved and an average of 428 men were used. The maximum during the present fiscal year was 52 camps and 2,300 men. At the end of the year this work was conducted from 30 camps and about 1,500 men were allotted. All of these camps are operated by the Forest Service, except one which is handled by the Department of the Interior. With the decrease in the number of camps it has been necessary to reduce the supervision, so that there are now 15 senior foremen, 15 foremen, 45 junior foremen, and 43 squad foremen assigned to this work. The squad foremen are enrolled in the camps and have been promoted to these positions on the basis of their interest and fitness to do the work. Two field supervisors have been designated to inspect the work done by the camp personnel in the field and to make contacts with the camp superintendents and State and Federal officials. These camps are in the western part of New Hampshire, the eastern part of Vermont, and the territory east of Berkshire County in Massachusetts, extending to, and in some cases beyond, the Connecticut River, and east of Litchfield County and beyond the Connecticut River in Connecticut.

Gypsy moth scouting or clean-up operations have been carried on in 174 towns in this territory, and in 107 of these some infestation has been found. In New Hampshire the area is rather heavily infested and the same is true in some of the towns bordering the Connecticut River in Vermont. The infestation is more serious in Massachusetts. Although there are some rather heavily infested areas in Connecticut, the infestation in general is not so severe as in Massachusetts.

As a result of the decrease in the number of camps and the curtailment of personnel, together with the reassignment of large numbers of these men for repair and emergency work in the flooded areas early in the spring, it was impossible to complete the program of work originally scheduled. The figures given in table 11, however, indicate that a tremendous amount of work has been done and that in the territory covered improved conditions as to infestation have resulted. The organization is now operating with increased efficiency, owing to the experience that has been gained during the last 2 years, although the periodical changes in personnel, which make it necessary constantly to train new men, have greatly increased the difficulty of supervision.

TABLE 11.—*Gypsy moth control work, fiscal year 1936*

State	Project	Scouting						
		Open country scouted					Woodland scouted	Egg clusters creosoted
		Open areas	Road	Apple trees	Oak trees	Shade trees		
		Acres	*Miles*	*Number*	*Number*	*Number*	*Acres*	*Number*
Maine	W. P. A.	215,668	3,252	444,151	19,207	185,836	56,241	75,333
New Hampshire	do	110,382	488	47,272	19,343	402,763	15,126	211,542
Do	C. C. C.	4,387	57	3,069	4,713	2,681	17,536	191,695
Vermont	W. P. A.	812,167	3,697	537,903	63,578	1,336,898	263,146	79,907
Do	C. C. C.	162,722	1,031	105,819	11,208	155,584	256,382	67,300
Massachusetts	W. P. A.	136,024	1,097	170,132	21,214	276,630	180,692	214,984
Do	C. C. C.	68,999	849	156,238	132,818	179,325	203,173	3,741,103
Rhode Island	W. P. A.	1,435	12	435	640	272	46,371	426,327
Connecticut	do	127,978	1,688	307,351	171,263	574,681	158,682	97,820
Do	C. C. C.	197,418	1,874	516,450	330,937	526,006	276,977	28,499
New York	W. P. A.	30,088	285	52,963	49,510	312,098	54,662	0
New Jersey	do	28,449	164	30,957	8,765	165,662	13,169	0
Pennsylvania	do	154,530	1,635	511,806	229,922	770,683	333,244	358,742
Total	W. P. A.	1,616,721	12,318	2,102,970	583,442	4,025,523	1,121,333	1,464,655
	C. C. C.	433,526	3,811	781,576	479,676	863,596	754,068	4,028,597
Grand total		2,050,247	16,129	2,884,546	1,063,118	4,889,119	1,875,401	5,493,252

State	Project	Chopping		Fencing		Banding		
		Woodland thinned	Trees cut in open	Wire erected	Wire removed	Burlap bands applied	Pupae crushed	Larvae crushed
		Acres	*Number*	*Feet*	*Feet*	*Number*	*Number*	*Number*
Maine	W. P. A.	185	3,026	0	0	0	0	0
New Hampshire	do	494	7,069	106,019	0	46,960	0	379,530
Do	C. C. C.	599	621			86,254	10	697,847
Vermont	W. P. A.	269	2,903	305,218	0	65,683	10	19,214
Do	C. C. C.	2,216	315			300,795	27,855	872,615
Massachusetts	W. P. A.	2,148	4,133	155,292	183,198	138,079	169,614	253,415
Do	C. C. C.	3,026	4,477			982,747	135,351	13,080,042
Rhode Island	W. P. A.	0	0	0	0	0	0	1,971
Connecticut	do	1,115	666	119,268	2,900	80,942	698	199,284
Do	C. C. C.	1,004	1,760			714,884	18,320	774,479
New York	W. P. A.	0	0	0	0	0	0	0
New Jersey	do	88	30	0	0	10,864	0	0
Pennsylvania	do	2,123	470	226,139	32,739	529,919	152,432	334,021
Total	W. P. A.	6,422	18,237	911,936	218,837	872,447	322,754	1,187,435
	C. C. C.	6,845	7,173			2,084,680	181,536	15,424,983
Grand total		13,267	25,410	911,936	218,837	2,957,127	504,290	16,612,418

TABLE 11.—*Gypsy moth control work, fiscal year 1936*—Continued

State	Project	Spraying					
		Date started	Date completed	Infestations sprayed	Woodland sprayed	Residential properties sprayed	Trees in open sprayed
		1936	1936	*Number*	*Acres*	*Number*	*Number*
Maine	W. P. A.						
New Hampshire	do	June 1	July 2	3	207	0	0
Do	C. C. C.						
Vermont	W. P. A.	June 1	July 2	11	1,238	13	678
Do	C. C. C.						
Massachusetts	W. P. A.	June 1	July 3	18	2,183	7	1,980
Do	C. C. C.						
Rhode Island	W. P. A.						
Connecticut	do	June 1	July 3	27	3,516	41	33
Do	C. C. C.						
New York	W. P. A.						
New Jersey	do						
Pennsylvania	do	May 18	July 2	157	9,641	6,522	132,042
Total	W. P. A.			216	16,785	6,583	134,733
	C. C. C.						
Grand total				216	16,785	6,583	134,733

PROGRESS IN GYPSY MOTH CONTROL

A decided gain has been made during the year in gypsy moth control. In Maine several infestations have been found outside the present gypsy moth quarantine line, but a considerable number of towns have been scouted along this border where no infestation has been discovered, and the same is true in northern New Hampshire. In Vermont two small infestations found outside the area under quarantine have been thoroughly treated, and it is believed that the insect has been exterminated in these localities. Treatment applied in the remainder of the New England area has been effective in materially reducing the infestation, as evidenced by the fact that in the treated areas no defoliation has been found during the present summer. Conditions in the barrier zone have improved as a result of the work, and no egg clusters have been found in New York west of the barrier zone or in New Jersey. Satisfactory progress has been made in Pennsylvania; although the scouting of additional woodland territory nearest the area first found infested has disclosed infestations, these were given prompt attention.

CONDITION OF GYPSY MOTH INFESTATION IN NEW ENGLAND

In the summer of 1935 defoliation by the gypsy moth was more extensive than that recorded the previous year. For the entire infested area 540,769 acres of woodland were found with from noticeable to complete defoliation, surpassing the total acreage recorded for 1934 by 48,408. In Maine and New Hampshire defoliation was much more extensive than in the previous year. Vermont showed somewhat of an increase, though defoliation has never been extensive in that State. For Massachusetts a considerable decrease was recorded; this resulted from a decided decrease in the southeastern portion of the State which was not entirely offset by very great increases in the area between the western border of Worcester County and the Connecticut River, in which section there was approximately five times as much defoliation as had been noted the previous year. Rhode Island showed quite a decrease from 1934, but Connecticut showed some increase. The acreage of defoliation immediately east of the Connecticut River was materially reduced during the summer of 1936.

BROWN-TAIL MOTH PROJECT

The brown-tail moth project was begun August 5, 1935, under a Works Progress Administration allotment for work on that insect in all of the New England States. It was necessary to organize this project in close cooperation with the

States concerned and to secure from each State so far as possible as many men from the respective State officers as could be obtained for supervisory purposes. The men engaged on the work were drawn from unemployed lists through the United States Employment Service and from Works Progress Administration rolls, 95 percent of which were from relief rolls.

The purpose of the work was to cut and destroy by burning all webs of the brown-tail moth in the infested territory; to examine carefully as much territory as possible immediately surrounding that infested; and in selected areas to remove favored food plants, particularly apple, wild cherry, and plum, and in this way render the area less susceptible to infestation. Worthless and uncared-for trees were treated in this way, as it is possible to control the insect satisfactorily in orchards where the trees are regularly cared for and sprayed.

The force was gradually increased during the fall and was continued until April 30, when it was too late in the season satisfactorily to remove the webs. The maximum number of men employed on this project was 1,800. Work was done in 366 towns in 40 counties of the 6 New England States, and 391,703 trees were cut and burned, a vast majority of these being worthless apple trees. In addition to this, cutting was done on 1,356 acres where individual trees and sprout growth, favorable as food for the brown-tail moth, occurred. The details by States and the totals are shown in table 12.

TABLE 12.—*Summary of work accomplished under Works Progress Administration brown-tail moth project, fiscal year 1936*

State	Trees cut	Area cut	Roadside scouted	Estimated area scouted	Trees examined	Brown-tail moth webs cut
	Number	*Acres*	*Miles*	*Acres*	*Number*	*Number*
Maine	74,394	0	10,616	976,672	5,019,670	1,256,085
New Hampshire	35,675	0	9,931	911,460	5,569,774	2,786,461
Vermont	102	0	781	71,852	432,402	0
Massachusetts	280,449	1,356	8,523	784,116	2,599,267	629,323
Rhode Island	1,083	0	2,696	248,032	576,716	306
Connecticut	0	0	1,844	169,648	1,014,819	0
Total	391,703	1,356	34,391	3,161,780	15,212,648	4,672,175

Observations made in the summer of 1935 indicated very little severe defoliation by this insect, but it did occur in a limited number of localities. The records given in table 12 show clearly that the insect occurred in sufficient numbers to cause a rapid increase of the pest if the work had not been done the following winter. In some sections of southern Maine, in the southern and eastern sections of New Hampshire, and in southeastern Massachusetts the infestation was heavy, and in two towns in Rhode Island adjoining the Massachusetts line small infestations were found which were the first that had been recorded in that State for many years. In some towns, particularly along the outside border of the infested area, no webs were found. It is apparent that if this project can be followed up continuously and intensively for a number of years, the infested area can be gradually reduced and the insect exterminated, as it is not known to occur in any other section of the United States.

CONDITION OF SATIN MOTH INFESTATION IN NEW ENGLAND

During the summer of 1935 the records obtained indicated that while this species has not reached the condition of abundance recorded in past years it is noticeably on the increase in a number of sections of the infested territory. In Massachusetts there were 11 towns, situated mainly in the eastern half of the State, in which noticeable defoliation was reported in the summer of 1935. In all cases this defoliation was confined to a very few trees. Reports of defoliation in restricted areas were received from three towns in New Hampshire, and noticeable defoliation occurred at one infested spot in Rhode Island.

GYPSY MOTH AND BROWN-TAIL MOTH QUARANTINE ENFORCEMENT

REGULATORY CHANGES

Under a revision of Notice of Quarantine No. 45, and supplemental rules and regulations, effective November 4, 1935, both lightly and generally infested areas remained unchanged. The revision included the addition to the quarantine notice of a proviso whereby the Secretary of Agriculture delegated to the Chief of the Bureau of Entomology and Plant Quarantine authority administratively to exempt from restriction certain articles which, owing to the nature of their growth, production, or manufacture are considered innocuous as carriers of moth infestation. The only revision in the regulations was the addition of sections to require that persons to whom certificates or permits are issued shall report, at the time of shipment, all consignments of quarantined articles to points outside the regulated area.

For the information of its transit inspectors and interested State officials, the Bureau, on February 6, 1936, issued a list of commonly shipped field-grown and greenhouse plants for which no gypsy moth certification is required. The perennial plants and shrubs listed are ones which under New England growing conditions do not have persistent woody stems and therefore could not harbor egg clusters of the gypsy moth. In more temperate sections of the country some of these plants are hardy enough to persist with woody stems. Examination of an individual plant of some of the exempt species in conjunction with transit inspection while en route, or terminal inspection in the State of destination, would not determine the status of the plant under the quarantine regulations. Therefore, the list of border-line plants was prepared and distributed as a guide to inspectors obliged to make such determinations.

CERTIFICATION OF QUARANTINED PRODUCTS

Inspection activities continued on the basis of 20 districts, with a single inspector in each to supervise all inspection requirements under both the gypsy moth and Japanese beetle quarantines. When needed during the nursery-shipping seasons and in the course of evergreen-products inspection, additional temporary employees were assigned to the districts.

Spruce-bough lot inspection in southern Vermont and western Massachusetts started late in October and continued until Christmas. With one exception, all lots inspected were found free from egg clusters. Seven temporary inspectors were assigned to spruce-bough lot inspection. One inspector was assigned at a Christmas-greenery establishment in Westminster, Vt.

Records for the 1935 season show that 590,105 Christmas trees which originated in the lightly infested gypsy moth area were inspected and certified for shipment to points outside the regulated areas. This quantity represents a 34-percent decrease in the number of trees inspected in the same area during the 1934 Christmas season. This decrease of more than 298,000 trees is attributed to the scarcity of good stands of balsam trees in the gypsy moth area and to losses sustained by shippers who in 1934 sold carloads on consignment. The maximum number of temporary inspectors employed during the Christmas-tree and greenery inspection was 47.

Nursery inspection required the assignment of additional inspectors in western Maine and western Massachusetts during the fall. Eight temporary men were engaged during October and part of November in making field inspection of nurseries that ship under joint Japanese beetle and gypsy moth certificates. All of the larger nurseries in the joint-certificate area east of the Connecticut River were scouted and found uninfested with either insect.

More infested shipments were found during the last half of July than in any similar period for the last 15 years. Inspections throughout the fiscal year resulted in the removal from material destined to nonregulated points of 1,844 egg clusters, 1,017 larvae, and 434 pupae of the gypsy moth.

Late in October it was learned that a number of abandoned railroad lines were being torn up in southern New Hampshire, and large quantities of steel rails were about to be shipped to steel mills outside the infested zones. Throughout the winter additional rails were taken up and shipped from northeastern Massachusetts and southern Maine. High prices for junk steel accounted for this unusual movement of rails from sections heavily infested with the gypsy moth. Inasmuch as steel products are not under regulation, voluntary arrangements were made with the railroads for inspection of all rails that had not been

loaded. Some shipments that already had been loaded or moved were inspected at the steel mills. During the winter inspectors traced the movement from the infested area of 336 carloads of steel rails. Inspection of 125 of these that were not immediately smelted resulted in the finding and destruction at the loading point of 95 egg clusters, and the finding of an additional 37 egg masses after delivery of 40 carloads to a steel mill at Syracuse, N. Y.

Tables 13 and 14 give summaries of the quantities of articles of the respective quarantined products certified during the year.

TABLE 13.—*Nursery stock certified under gypsy moth and/or Japanese beetle quarantines, fiscal year 1936*

Material	Quantity	Certificates issued	Gypsy moth egg clusters found
	Number	*Number*	*Number*
Shrubs	715,822	5,094	
Specimen trees	13,376	780	10
Young trees	414,014	995	
Specimen evergreens	289,440	2,064	30
Young evergreens	1,657,485	6,784	6
Seedlings, cuttings, and small plants	945,360	4,441	1
Potted greenhouse plants	44,936	902	
White pine trees	41,412	102	
Total		21,162	47

TABLE 14.—*Evergreen products, forest products, and stone and quarry products, certified under gypsy moth quarantine, fiscal year 1936*

Material	Quantity	Certificates issued	Gypsy moths found	
			Egg clusters	Larvae and pupae
Evergreen products:	*Number*	*Number*	*Number*	*Number*
Boughs, balsam twigs, and mixed greens--boxes or bales	37,245	4,190	1	2
Christmas trees--number	676,544	1,198		
Laurel--boxes or bales	10,176	2,616		1
Miscellaneous--boxes	15.498	8,256		
Total		16,260	1	3
Forest products:				
Barrel parts, crates, crating--bundles or cases	62,762	1,272	28	
Logs, piles, poles, posts, ship knees, and ties--pieces	275,319	2,873	315	
Fuel wood--cords	5,804	689	170	
Pulpwood--do	29,404	1,823		
Lumber--board feet	30,660,856	4,662	516	1,236
Empty cable reels--number	20,020	3,297	45	107
Shavings--bales	35,084	244		
Shrub and vine cuttings--boxes	436	104		
Miscellaneous--number	909,320	1,267	99	
Total		16,231	1,173	1,343
Stone and quarry products:				
Crushed rock--tons	3,036	36		
Curbing--running feet	67,434	226	19	31
Feldspar--tons	11,517	745		
Granite--pieces	37,519	5,996	42	
Monumental stone--do	18,385	13,163		65
Grout--tons	22,217	104		
Marble--pieces	149	84		
Paving blocks--number	1,860,861	552	430	9
Miscellaneous--pieces	31,114	241		
Do--tons	3,824	85		
Total		21,232	491	105

ROAD PATROL

Vehicular-inspection stations were operated on 12 important highways leading from the generally infested zone. Three posts were established in Massachusetts in mid-October, and nine stations were opened in Connecticut between October 31 and November 17. All posts operated continuously until May 15, except for a few days' interruption in severe weather when icy roads made it hazardous to attempt stopping traffic. This phase of the work was financed by Works Progress Administration funds made available for control and prevention of spread of the gypsy moth. Cards describing the gypsy moth and recommending control measures were distributed to passing motorists desiring further information concerning the insect. While these stations were in operation, 2,394 vehicles containing products covered by the regulations were stopped. In addition, 107 five-leaf pines being transported contrary to the restrictions of Quarantine 63 were confiscated. Many of the white pines intercepted were badly infected with the white pine blister rust. Further, 256 shipments moving in violation of the satin moth quarantine were intercepted. Operation of the road patrol was responsible for the inspection of a truck load of cordwood en route from Wolfeboro, N. H., to New York City. Examination of the cordwood disclosed 20 gypsy moth egg clusters. Six other egg masses were found in two lots of infested material intercepted at the road stations.

VIOLATIONS

Prosecution was pending at the end of the year in a case involving a boat shipment of uncertified forest products from Stonington, Conn., to Greenport, N. Y. In the course of the year, investigations were made of 372 apparent violations of the gypsy moth and brown-tail moth quarantine.

DUTCH ELM DISEASE ERADICATION

GENERAL STATUS

Several factors in this year's set-up of the organization for Dutch elm disease eradication contributed to a degree of continuity not hitherto achieved since eradication measures were begun in 1933. Settlement on a definite policy and division of functions mutually satisfactory to the Bureau and the cooperating Federal and State agencies furthered a direct and speedy approach to the problem of effectively ridding the known infected zones of the disease fungus and searching out other possible centers of infection. General supervision of the work was unchanged throughout the year. Allotment by the Works Progress Administration of sufficient funds for skilled and unskilled labor permitted the building up of a large organization for a delayed summer scouting program and a comprehensive eradication and sanitation campaign during the winter and spring. A nucleus of trained scouts from the carry-over of relief personnel was also available for early summer scouting in 1936. Finally, by the time for reorganization of summer scouting in 1936 the supervisory force had become somewhat accustomed to training wholly inexperienced men in scouting and eradication procedure.

SYSTEMATIC SCOUTING

Known cases of the Dutch elm disease on record at the beginning of the year included 61 in Connecticut, 5,796 in New Jersey, 3,004 in New York, and 17 outside the tri-State infected area—a total of 8,878.

Systematic scouting for diseased trees was performed from about July 1 to September 15. Organization of the crews was under way at the beginning of the year. Additional scouts were added until on August 24 there were 1,038 crews in the field. Not until early in September did the number of employees on work-relief funds reach its maximum of slightly over 3,800 men.

Many difficulties presented themselves in the hiring, training, and equipping of these scouts. In some sections it was difficult to secure men from the local National Reemployment Service offices. The men had to be trained to recognize an elm and distinguish symptoms of the disease. Field orientation, map reading, and tree climbing were also included in their training. Even after assignment to a scout school the number of men completing the course and qualifying for this type of work was limited. Performance of the men for the first month

was mediocre, owing to their inability to distinguish between symptoms of the disease and other physiological factors that induce wilting. As the season lengthened, many of the men became more proficient in detecting the disease. Late in the season a waiver of the 90-percent relief requirements on 500 men made it possible to reemploy for a short time some of the scouts that had been laid off the preceding May and to hire qualified nonrelief men for scouting in the outside areas. At the conclusion of foliage scouting the force was reduced to approximately 2,100, and the men retained were transferred to eradication and sanitation work.

Owing to the delay in starting the summer scouting and the inexperience of the scouts, it proved impossible to complete the three surveys of the entire work area as originally planned. However, there was one complete covering of the entire infected zone, approximately two-thirds of the infected territory was covered twice, and a few sections received three surveys. Scouting of the protective band was limited to a single systematic survey of about 60 percent of the area and a resurvey of 20 percent of the territory.

Scouting in outlying cities where diseased trees had been found in previous years was started about July 15. When additional funds later became available, scouts were assigned to the cities exposed to infection when imported burl elm logs were landed in this country and transported to veneer factories. A maximum of 104 relief workers were used in the outside scouting activities in Baltimore, Cincinnati, Cleveland, Indianapolis, Norfolk, New Orleans, Knoxville, Louisville, Kansas City, Chicago, Dayton, Philadelphia, and Boston.

Scouting of railroad rights-of-way over which imported burl elm logs traveled en route to veneer factories in the Middle West disclosed a new spot of infection containing three diseased trees about 50 miles west of Baltimore near the Baltimore & Ohio Railroad transfer center at Brunswick, Md. A sample plot of dead and dying elms established during the fall in the infected section of Cleveland also disclosed 23 diseased trees. Residual infections were also found in 10 trees in Indianapolis and 3 elms in Norfolk. Infected trees found in these three cities were in the same general vicinity in which diseased trees had been removed in 1934.

Several staff members made a number of trial flights in both an autogiro and an airplane late in the summer of 1935 to determine the possibilities of using aircraft in spotting concentrations of the disease and in locating dead and dying elms that might harbor infection or furnish breeding places for insect carriers. These observations indicated that by virtue of its slow flight and maneuverability an autogiro could be used to advantage in aerial scouting over rough terrain not easily reached by scouts afoot. After considerable search to find a suitable plane, delivery was accepted on March 14 of a two-seated PA–18, 1933 autogiro. During part of April the autogiro was utilized for a citrus canker survey of marshland areas along the Gulf coast of Louisiana and Texas. Systematic autogiro scouting with a pilot and observer began in the northwestern counties of New Jersey on June 10. Aerial photographic maps of the territory flown were used for orientation and location of wilted trees showing apparent characteristics of the Dutch elm disease. After receiving the marked maps, ground crews relocated the trees and cut samples for laboratory culturing. No difficulty whatever was experienced by the ground crews in locating trees spotted by the aerial scout and marked on the air maps. It has been estimated that it requires a ground crew of eight men scouting for 30 days to cover territory that may be scouted in a single day from the autogiro. During June the aerial crew spotted 115 wilted elms. Of this total, three elms were subsequently confirmed as infected with the disease.

Wilting and discoloration characteristic of the Dutch elm disease in 1936 were first found on May 22. General wilting of elm foliage was observed during the first week in June.

Scout schools were inaugurated shortly after the middle of May for the training of scouts for the 1936 season. Most of the men assigned to the schools were those with previous scouting experience or members of sanitation crews who had proved their adaptability to this type of work. On June 8 the trainees were organized into crews and placed in the field. By the end of June there were 241 five-man scout crews in the field. This number of Works Progress Administration crews was supplemented by 100 crews composed of Civilian Conservation Corps enrollees. Men on the W. P. A. pay roll at the end of the year numbered 883. The remainder of the personnel was composed of 92 appointees, 229 per diem workers on regular funds, 19 State-appointed personnel, 219 State per diem workers, and 810 C. C. C. enrollees.

Soon after early-season scouting began in June 1936, two additional cases of the disease were found in Indianapolis and single cases were reported from Baltimore and Norfolk. Infected trees found in outlying areas from 1930 to the end of the fiscal year were as follows: Baltimore 2, Brunswick 3, Cleveland 33, Cincinnati 1, Indianapolis 16, and Norfolk 5—a total of 60.

During the year samples were collected from 50,729 trees showing apparent symptoms of the disease. Of these, 6,595 were found upon culturing to be infected with the causal organism. Segregated as to location, 99 were found in Connecticut, 4,313 in New Jersey, 2,140 in New York, and 43 at the four isolated infections in Indiana, Maryland, Ohio, and Virginia.

Infected trees reported from all sources during the previous fiscal year numbered 5,613. In comparison, there was a 17-percent increase in the number of infection cases in the fiscal year 1936.

On a straight comparison of diseased trees discovered by scouts examining elms in foliage, the 1935 calendar year total is approximately 5,700, as compared with over 6,900 found by scouts in the summer of 1934. Infection discovered in the course of the survey of dead and dying elms following the 1935 scouting and the intensive elm-sanitation campaign in the winter of 1935–36 contributed heavily toward the confirmations recorded during the present year.

Addition of the present year's confirmations to the previous totals brings the grand total of known disease cases on record in the United States on June 30, 1936, to 15,473, 160 of which are in Connecticut, 10,109 in New Jersey, 5,144 in New York, and 60 at the six isolated infection centers.

EXTENSIONS OF WORK AREA

Twenty-four elms infected with the disease fungus were found by scouts working in or just outside the 10-mile protective zone surrounding the known infected territory in New Jersey and New York. There were no extensions of the infected zone in Connecticut. Single cases of the disease were found in the towns of Carmel and Southwest, Putnam County, and in the towns of Bloomingrove and Monroe, Orange County, N. Y. Infection centers containing five trees each were found in Union Township, Hunterdon County, and Wantage Township, Sussex County, N. J. Additional confirmations in New Jersey included three trees in Holmdel Township, Monmouth County; two cases each in Sparta Township, Sussex County, and Independence Township, Warren County; and single confirmations each in Tewksbury Township, Hunterdon County; Vernon Township, Sussex County; and White Township, Warren County.

With the addition of the territory necessary to circumscribe these new infections the infected zone at the end of the year totaled 4,307 square miles, of which 2,529 square miles were in New Jersey, 1,495 in New York, and 283 in Connecticut. This was an increase during the year of 1,829 square miles in the known infected area. This increase in area cannot, however, be attributed to the current year's dissemination of the disease, since examinations of the annual rings of some of the trees showed the fungus to have been present in growths as far back as 1933. The disease apparently was in the trees for several years but lack of scout personnel had made it impossible to survey these areas. Discovery of infection centers in northwestern New Jersey pushed out the 10-mile protective zone around the periphery of the infected zone to include 90 square miles in Pennsylvania. This was the only important change in the extent of the border zone. The protective strip at the end of the year included 2,345 square miles, and the total work area comprised 6,652 square miles.

For the purpose of adding to the regulated area the newly discovered infections an amendment to the regulations supplemental to Notice of Quarantine No. 71 was made effective April 1, 1936. The modification added seven townships in Hunterdon County, one township in Middlesex County, three townships in Monmouth County, two in Morris County, five in Sussex County, and eight in Warren County, N. J. In New York added areas comprised seven towns in Orange County, four in Putnam County, and two in Westchester County. There were no further changes in the regulations.

ERADICATION AND SANITATION ACTIVITIES

There was no difficulty this year in eradicating diseased trees as rapidly as their presence was confirmed and permissions were obtained for their removal. State officials made all preliminary arrangements for removals, while the trees were actually removed by Federal or State eradication crews or on State con-

tracts according to the funds available for this phase of the work during the different periods. The accumulation of standing infected trees at the beginning of the year was 726. The backlog as of June 30 was 805 trees, all of which were scheduled for immediate removal.

At the close of the scouting season the available personnel was transferred to sanitation work. In conjunction with summer scouting, men in Connecticut and New York had tagged all dead and dying elms over a large part of the infected zone. In New Jersey the tagging did not begin until the elms had started to drop their foliage. Throughout the winter the sanitation crews continued their scouting for these dead and decadent elms while other crews removed these possible sources of disease fungus or insect vectors.

In addition to the sanitation work, a considerable number of relief workers were assigned, early in August, to eliminate all elms from several swamp areas in New Jersey. Concentrations of the disease had been found in these sections, and clear cutting was determined as the only practicable method of eradicating all possible infection. By rendering these areas elm-free the necessity for their periodic scouting was eliminated and an extensive population of insect vectors of the disease was destroyed.

Sanitation crews destroyed 825,000 dead and dying elms, and clear-cutting crews in the swamp areas removed an additional 385,000 trees.

As a result of the finding of disease in a sample plot of dead and dying trees in Cleveland, a sanitation program was started late in November in an area of about 40 square miles, including a strip along Lake Erie about 2 miles wide. This work was still in progress at the end of the fiscal year.

At the isolated infection center at Old Lyme, Conn., an intensive sanitation project, involving the pruning of 1,149 elms, was carried on from August 1 to October 11. This eliminated all dead and weakened parts which constituted the principal sources of infection and insect carriers of the disease. Scouts working in this area during June 1936 were able to sample only one tree that later proved to be infected with the disease.

IMPROVED METHOD IN SCOUTING AND ERADICATION

New equipment and improved methods contributed materially to accomplishments in eradication of condemned trees. Since many of the newly trained scouts had difficulty in acquiring the deftness necessary for throwing a rope through a crotch in a tree to be climbed, they were provided with wooden balls attached to a draw cord. These balls are easily thrown through a crotch, and it is then a simple operation to pull the climbing rope through. This saved considerable time previously spent in getting ropes into the taller trees.

By means of a large photographic reproduction unit, adequate maps were prepared for the use of all field crews. Aerial maps were also procured for use of scout and eradication crews as well as the autogiro pilot and scout-observer.

Eradication crews were equipped with well-made hand tools for sawing or chopping down trees and burning the logs. Huge kerosene blow torches were provided for starting log fires in wet weather, when most of the burning was done.

Much of the work of assembling data showing crew performance, formerly performed by scout supervisors and State leaders, was eliminated by the establishment of a statistical unit in the field headquarters to compile all needed information directly from original records submitted by each crew.

Probably of greatest assistance in expediting eradication work, particularly in the clear-cutting of swamp areas, were the power saw units. Each of the four units in operation consists of an air compressor mounted on a caterpillar tractor. The compressor is of sufficient capacity to operate two pneumatic chain saws. A 3½-ton truck is used to transport the tractor and equipment between work sites. Trees that ordinarily would require 2 or 3 days for hand crews to eradicate may be taken down and destroyed in from 6 to 8 hours by the power saw units. There are also available 12 gasoline-powered drag saws. These are used principally in the clear-cutting operations.

Research workers of the Bureau of Plant Industry and this Bureau in cooperation developed a method of treating stumps with copper sulphate which prevents sprouting and which, at the same time, offers promise of preventing bark-beetle attack on these stumps. This method of treatment involves pouring the powdered copper sulphate into pockets made by separating the bark from the

wood. The new method eliminates the former tedious procedure of debarking the stump and painting it with creosote.

In wooded areas the introduction of strip scouting with small scout units combined into large crews and deployed in parallel lines across the strip to be surveyed permitted an increased rate of coverage under closer supervision than had been the case with the regular crew alinement.

Tests with a number of different types of filtering spectacles resulted in the selection of a type of spectacle which filters out greens and emphasizes browns and yellows, thus making wilted or yellowed leaves conspicuous against a background of healthy foliage. These may be of assistance in future scouting.

To meet the need for a lightweight, extensible pole pruner required by scouts in collecting twig samples, several sizes of telescoping pruners were constructed from aluminum alloy tubing. After the pruning knife is hooked over a branch, a turn of the pole closes the knife and snips off the sample. When these are obtained in quantity, they will greatly assist in scout work.

Form letters describing the object of Dutch elm disease survey work were supplied to New Jersey scouts for distribution to property owners whose premises were entered. Signs for nailing to each tree sampled were also adopted by the New Jersey Department of Agriculture.

Inauguration on January 1 of an 8-hour day to replace the former 6½-hour daily work period increased production, since fewer hours were devoted each month to conveying the crews to and from their work sites.

Speedy laboratory determination of samples gathered by scouts was facilitated by a night messenger service, whereby daily collections were delivered to the laboratory before work began the following morning.

CIVILIAN CONSERVATION CORPS COOPERATION

Although for several years men have been furnished by the Emergency Conservation Work Administration for the removal of diseased and dead or dying elms, the contribution of this branch was more definitely organized by the establishment during August and September of five C. C. C. camps devoted exclusively to Dutch elm disease control. Early in December a sixth camp was constructed. The camps are located at West Milford, Raritan, and Denville, N. J., West Haverstraw and Highland Mills, N. Y., and near Danbury, Conn. Enrollees from these camps engaged in all phases of the work, including scouting, elm sanitation, and clear-cutting in swamp areas. Control activities of the enrollees are supervised by experienced men trained and recommended by this Bureau.

SOURCES OF FUNDS

Supplementing an original allotment of $250,000 of Works Progress Administration funds made on May 28, 1935, a further assignment of $2,500,000 from the same source was made on July 30, 1935. This carried the work through until the end of the year. On June 24, 1936, work-relief funds amounting to $165,400 were allotted to be used for building up the scouting force at the beginning of the next fiscal year. Funds allotted to Dutch elm disease eradication in the Agricultural Appropriation Act for the fiscal year amounted to $261,156.

State funds appropriated for Dutch elm disease control during the year amounted to $12,500 in Connecticut, $50,000 in New Jersey, and $150,000 in New York. During July, August, and the first half of September, New York placed from 60 to 100 trained scouts and supervisors in the field. From September 15 to November 15, New Jersey employed 55 men to assist in tagging dead and dying trees and in supervising sanitation crews. This assistance, especially in the supervision, added materially to the efficiency of the work performed by W. P. A. employees.

Mutually helpful cooperation has been accorded the Bureau by officials of the three infected States, and unanimous public support has greatly assisted in furthering the eradication activities.

TRANSFER OF FIELD HEADQUARTERS

Effective April 6, the field headquarters supervising Dutch elm disease eradication, European corn borer certification, and Japanese beetle and gypsy moth quarantine enforcement was transferred from White Plains, N. Y., to a three-story brick building in Bloomfield, N. J. The former New Jersey district office

at East Orange and the garage for housing eradication equipment and motor vehicles at West Orange were merged with the field headquarters. The New York State leader's office was kept in White Plains but was moved to another building where office and garage space could be combined.

INFORMATIONAL ACTIVITIES

Considerable publicity was given the Dutch elm disease during the fiscal year, both in the press and in specialized magazines. Numerous radio and press releases were made through the Office of Information of the Department. Riker mounts containing material to illustrate the nature of the fungus and its carriers were distributed to individuals who could be of assistance in the eradication work. Exhibit material was on display in connection with the National Flower Show at Baltimore, Md., at a National Emergency Council exhibit in Paterson, N. J., and at several other meetings.

WHITE PINE BLISTER RUST CONTROL

BLISTER RUST REACHES NORTHERN CALIFORNIA

The outstanding feature in the spread of white pine blister rust during the year was the discovery of this disease on sugar pine in northern California on June 29, 1936. This is the first time the rust has been reported from California. While its establishment in this State constitutes a direct threat to about 2,000,000 acres of valuable sugar pine forests, the eventual spread of the rust into California had been anticipated and the protection of the sugar pine was already under way, with the result that initial control has already been established on over 400,000 acres of these California forests.

During 1935 blister rust was identified on *Ribes* in Curry County, Oreg., approximately 50 miles from the California border, where it had previously been found in 1929 and 1931. It was also discovered on *Ribes* about 65 miles from the California line on the Rogue River National Forest in Jackson County.

Of the 408,657 acres of valuable sugar pine forests already protected in California and Oregon, 85,158 acres were brought under protection during 1935 and 7,951 acres were given a second working. The eradication operations were carried out in cooperation with the Federal Forest Service and the States concerned. The continued vigorous prosecution of this control work will make it possible to prevent the losses that might occur if control methods were not applied until after the disease began to appear.

The protective measures which have proved economical and effective in preventing blister rust losses in all pine-growing regions consist of the destruction of currant and gooseberry plants (*Ribes*) growing in or near the pine stands and the maintenance of the areas in a relatively *Ribes*-free condition. This *Ribes*-eradication program can thus be undertaken in advance of the arrival of blister rust, and that plan is followed wherever possible.

ABOUT HALF OF THE WESTERN WHITE PINE AREA PROTECTED

In the western white pine area of eastern Washington, northern Idaho, and western Montana blister rust was found during the year to be generally distributed on the sticky currant, *Ribes viscosissimum*, an upland species. Heavy infection was found on two stream-type species, *R. petiolare* and *R. inerme*, on Lake Creek, north of Bull Lake, on the Kootenai National Forest in Montana, and pine infection was also located for the first time in this forest. The number of locations of known pine infection centers in this general area was increased from 129 to 208, distributed in or near the following national forests: Lolo, 1; Clearwater, 51; St. Joe, 116; Coeur d'Alene, 17; Kaniksu, 12; Cabinet, 5; Kootenai, 2; and 4 near Mount Spokane. These discoveries represent a slight extension of known locations westward to the Mount Spokane area and northward in the Kaniksu National Forest in Idaho.

The best of the white pine land and timber in this western white pine area occupies approximately 2,710,000 acres, about one-half of which is in public ownership. Control efforts are aimed at establishing and maintaining control of the disease on this area in cooperation with the Forest Service, the National Park Service, the States, and the landowners, so as to make it safe for the continued production of white pine. During 1935 (table 15), 272,718 acres were cleared of *Ribes*, bringing the total acreage covered since the work was begun

to 1,391,884 acres, or approximately one-half of the area. Of this acreage, 1,328,787 acres represents initial working, 59,523 acres have been given a second eradication, and a third working has been necessary on 3,574 acres.

TABLE 15.—*Ribes-eradication operations for the calendar year 1935*

Region	Total pine area of sufficient value to justify protection [1]	Control area (including border zones) [1]	Area covered in 1935	Effective labor in 1935	*Ribes* destroyed in 1935
	Acres	*Acres*	*Acres*	*Man-days*	*Number*
Northeastern States	7,667,127	12,572,879	1,125,198	381,554	28,828,809
Southern Appalachian States	1,275,081	3,831,204	999,116	34,327	3,690,622
Lake States	1,254,394	4,260,757	483,877	183,917	39,219,729
Western white pine (Idaho, Montana, Washington, including Mount Rainier)	2,710,129	2,710,129	272,718	236,854	53,514,386
Sugar pine (California and Oregon)	2,200,316	2,200,316	93,109	45,216	15,013,191
Rocky Mountain States (Colorado and Wyoming)	394,548	394,548	8,383	2,209	233,933
Total	15,501,595	25,969,833	2,982,401	884,077	140,500,670

[1] Pine and control-area acreages materially revised from figures given in previous reports, especially as to pine acreages in the Southern Appalachian and Lake States. The revised estimates are based on forest surveys carried out in 1935 and 1936.

A strip survey was conducted late in the fall of 1935 in order to procure a sample of average pine-infection conditions in the western white pine region. Of 27,144 pines examined, 417, or 1.54 percent, were infected. The heaviest infection was found in and near the St. Joe National Forest, where 345 of the 8,350 pines examined, or 4.13 percent, were infected. The percentage of infection found on the other pine-growing national-forest areas of the region was as follows: Clearwater, 1.85; Coeur d'Alene, 0.65; Kootenai and Cabinet, 0.07. The survey strips were so located as to represent average conditions as far as possible, without regard to whether they ran through protected or unprotected territory. The figures given show the percentage of trees with visible blister rust cankers and therefore do not include trees infected within the last year or two, since the cankers on them are still in the incubation period of the rust.

Work was continued on the improvement of chemical methods of destroying *Ribes*. Tests of the decapitation method on the Sierra gooseberry (*R. roezli*), consisting of the removal of the top of the bush by cutting through the crown and the application of the chemical to the cut surface, showed that Diesel oil is the cheapest and most effective chemical for this species. Borax is not sufficiently toxic to it for regular eradication work, in marked contrast to its effectiveness on *R. viscosissimum*. Decapitation tests in Idaho showed that decapitation and chemical treatment of the sticky currant (*R. viscosissimum*), the prickly currant (*R. lacustre*), and the rock gooseberry (*R. irriguum*), constitute an effective eradication practice. A study of the squaw currant (*R. cereum*) plots in Oregon showed that only those methods which involve the sprinkling of Diesel oil on intact and on decapitated crowns warrant consideration as eradication methods. One hundred percent destruction of large squaw currant clumps can be accomplished by sprinkling the decapitated crowns with an average dose of one-third of a gallon of Diesel oil per clump.

NEW INFECTION FOUND IN LAKE STATES

Indiana and Illinois were added in 1935 to the list of infected States, the rust having been found on *Ribes* in Lagrange and La Porte Counties, Ind., and in Jo Daviess County, Ill. In addition, infection on *Ribes* was reported for the first time in Trumbull, Portage, and Summit Counties, Ohio; Iron, Outagamie, and Waushara Counties, Wis.; and Allegan County, Mich. Pine infection was found for the first time in Wayne County, Ohio; Rusk County, Wis.; and Delta, Benzie, Newaygo, and Montcalm Counties, Mich. A large number of young cankers and new infection centers were found in the Lake States, indicating that the amount of rust was increasing at a rapid rate on unprotected pine. In Wisconsin, Minnesota, and Michigan pine infection was found quite generally

distributed in several counties in which only one or a few pine infection centers had been previously known.

In the Lake States region 483,877 acres were cleared of 39,219,729 *Ribes* during 1935, in cooperation with the Forest Service, the Indian Service, and the States concerned, as recorded in table 15. This includes 23,992 acres that were given a second working and 1,400 acres that received a third working. From 1918 to 1935, inclusive, 95,763,280 *Ribes* were destroyed on 1,218,451 acres of land, or over a fourth of the control area. This region originally supported one of the most extensive and finest virgin white pine forests in the country. While nearly all the virgin pine has been cut, there remain over 1,250,000 acres of valuable second growth, and white pine is also being used extensively to reforest large areas of forest land that might otherwise remain in an unproductive condition.

NORTHEASTERN STATES NOW LARGELY INITIALLY PROTECTED

In the Northeastern States 684,285 acres were brought under initial protection in 1935, the Federal, State, and local governments working in cooperation, and 440,913 acres were given a second coverage. In this region control operations have been in progress longer than in any of the other white pine regions of the country, and five-sixths of the white pine area has been brought under initial protection. Since the work was first started, 160,808,360 *Ribes* have been destroyed on 12,115,813 acres of white pine land, including 1,942,913 acres that have been given a second working. This work has effectively brought the disease under control on these areas.

RIBES ERADICATION IN SOUTHERN APPALACHIAN REGION

In the Appalachian region initial control work, which was not started on an extensive scale until the emergency work programs were undertaken in 1933, has now been completed for the present on the white pine areas of Kentucky and South Carolina. In the other Appalachian States the work has made good progress during the year, a total of 3,690,622 *Ribes* having been eradicated from 999,116 acres. In general, *Ribes* are much less numerous than in the other white pine regions of the country, and this makes it possible to work a much larger acreage per man-day. As the disease is gradually spreading southward, the timely eradication of *Ribes* should keep the white pine areas in condition for the safe production of white pines as a timber crop at small cost.

The rust was found in 1935 on *Ribes* and on white pine farther south in Augusta County, Va., than was heretofore known. It is now quite generally distributed in several of the infected counties of Virginia and West Virginia. One important finding was a heavy blister rust infection on European black currants in Norbeck, about 12 miles north of the District of Columbia, in Montgomery County, Md.

NURSERY PROTECTION AND CULTIVATED BLACK CURRANT ERADICATION

In order to prevent the distribution of the disease through the movement of infected white pine planting stock, *Ribes*-free zones are established and maintained around nurseries, in cooperation with the owners. This work makes it possible for purchasers of white pine ornamental or forest planting stock to obtain trees raised under conditions that assure their freedom from blister-rust infection. In establishing these zones all *Ribes* are eradicated within 1,500 feet and all cultivated black currants within 1 mile of the nurseries. These zones are kept free of *Ribes* by yearly inspection and reworking where necessary. During 1935 this work was carried on around 59 nurseries, thus affording protection for millions of white pines being grown for forest and ornamental planting.

The European or cultivated black currant (*Ribes nigrum*) is more susceptible to blister rust than any other species of *Ribes* and is one of the chief agents in its long-distance spread and local establishment. The eradication of this plant in white pine regions is a general control measure that will be of material aid in checking the spread of the disease. The cultivated black currant should not be grown in white pine regions. It is an introduced plant that seldom escapes from cultivation, and its economic importance and value, as compared with that of the white pines, is very small. During the past season 51,903 of these plants were eradicated in the eastern white pine regions. In the western white pine and sugar pine regions all such black currants as have been found were eradicated several years ago.

SUMMARY OF FIELD OPERATIONS

Large-scale work programs for the control of white pine blister rust were carried on successfully during the year in cooperation with 31 States and with Federal agencies responsible for the administration of public lands. The work was continued in July 1935 with the balances of funds allotted by the Public Works Administration, supplemented by labor from the Civilian Conservation Corps; the latter was used throughout the season in white pine areas located within working distances of Civilian Conservation Corps camps. The last of July additional emergency funds were made available to the Bureau for continuing the control work in 28 States under the Emergency Relief Appropriation Act of 1935, and these amounts were supplemented by allotments and contributed services from other Federal agencies and from State and local governments and private owners.

In 1935 the white pines on 2,982,401 acres of control area were protected by the eradication of 140,500,670 *Ribes*, with an expenditure of 884,077 man-days of labor. In this work the Civilian Conservation Corps supplied 483,571 man-days of labor and destroyed 69,983,328 *Ribes* on 922,974 acres of land. The remainder of the work was performed with regular, State, and local cooperative funds and allotments under emergency appropriation acts. Approximately 20,000 men were employed on this work, about half of whom were security-wage workers and the others C. C. C. enrollees assigned to this project from 280 camps. In addition, protective zones totaling 44,216 acres were eradicated of *Ribes* around 59 white pine producing nurseries to assure the production of disease-free planting stock; 51,903 cultivated black currants, the chief agent in the long-distance spread of the rust, were destroyed; white pine areas aggregating 2,364,185 acres were located and mapped to determine the extent and value of the white pine growing thereon and the best and most economical *Ribes* eradication methods to be employed; 39,407 planted and ornamental white pines of high value were treated for the elimination of infection by removing 65,823 blister rust cankers; and 67,666 diseased trees that could not be saved were destroyed in plantations and parks.

The land area in this country on which currants and gooseberries (collectively called *Ribes*), the alternate host plants of the rust, should be suppressed to protect the white pines aggregates some 25,969,833 acres. This control area supports over 15,501,595 acres of commercially valuable white pine timber and the younger growth that will form the next crop. The stumpage value of the timber is estimated to be about $400,000,000 and much of it is in public ownership. Under the emergency relief and previous work programs approximately three-fifths of the control area has been protected by the initial eradication of *Ribes*. In addition, 14 percent of the protected acreage has been worked twice and about 1 percent three times to keep the *Ribes* suppressed and the disease under control. In accomplishing these results over 553,558,883 *Ribes* have been destroyed during the working of 17,387,243 acres in the control areas. The emergency relief work programs of the last 3 years have made possible a rapid increase in the progress of this work. Under these programs over 393,784,902 *Ribes* have been removed from 6,741,885 acres with 2,168,667 man-days of labor. In the last 3 years considerably more than half as much pine acreage has been brought under control as was accomplished in the previous 15-year period.

Very little new infection is occurring on white pines in those areas that have been brought under control by the eradication of *Ribes*, but in similar unprotected areas the rust is accumulating each year and causing serious losses in white pine stands, particularly among the younger age classes.

ENFORCEMENT OF THE WHITE PINE BLISTER RUST QUARANTINE

The demand for five-leaved pines during the past 2 years has increased to a marked extent owing apparently to recognition by the public of the value of such trees in reclaiming idle lands that are not well adapted for the usual farm crops, in planting watershed areas, and in preventing soil erosion.

Under the regulations of the white pine blister rust quarantine, the interstate movement of five-leaved pines from the infected States to any State other than to New York and New England is authorized only under Federal pine-shipping permit. Such permits are issued only for five-leaved pines which have been grown from seed under prescribed sanitation conditions. In order to comply with these requirements it is usually necessary to have a crew cover the 1,500-foot zone around the five-leaved pine block one or more times each spring after

the initial eradication work has been done, in order to remove sprouts and seedlings of currant and gooseberry plants that come up thereafter. The supervision for this type of work is furnished by the Bureau, with labor needs usually supplied by the applicant. The mile zone must also be covered to detect and remove all European black currant plants that may be present. The practicability of growing rust-free pines in infected areas, under these requirements, has been demonstrated.

During the year applications covering 57 nurseries were received. Owing to the fact that the leaves of currant and gooseberry plants normally appear from one to several weeks in advance of much of the competing vegetation, eradication early in the spring is much more effective and less costly than similar work at a later date. Early work is also desirable because the pine-infecting stage of the rust seldom appears on currant and gooseberry leaves until late in June or early in July. Therefore, the Division of Domestic Plant Quarantines, which is responsible for enforcing the quarantine regulations, assigned inspectors to inspect the premises of applicants for permits early in the spring to determine the approximate date when crew work should be started around each nursery involved. This information was passed on to the Division of Plant Disease Control, which is responsible for supervising the eradication work.

Eradication and inspection of the sanitation zones around the nurseries of applicants were completed in all but a few cases prior to the latter part of June. The sanitation zones around the nurseries of 28 applicants were found to be in a satisfactory condition and permits were issued. Twenty of these permits were issued to commercial concerns and eight to Federal or State agencies.

The application of 1 nursery was denied because nonprotected pine had been purchased, the applications of 12 nurseries in which the five-leaved pines had not reached a salable size were tentatively approved, 2 applications were withdrawn, and action is pending in 14 cases. In 11 of these 14 nurseries no five-leaved pines are now being grown, so eradication early in the spring was not necessary. Eradication work will be carried on during the summer and inspection will be made promptly upon completion of such measures. During the year 91 violations of the quarantine regulations were intercepted by transit inspectors.

WOODGATE RUST QUARANTINE

The Woodgate rust quarantine, which has been in effect since November 1928, was issued for the purpose of preventing the spread of the Woodgate rust, a disease which attacks Scotch and other hard pines. No spread of the disease, outside the present regulated area comprising the counties of Clinton, Essex, Franklin, Hamilton, Herkimer, Jefferson, Lewis, Madison, Oneida, and St. Lawrence, in the State of New York, was reported. One violation of the quarantine was intercepted during the year by transit inspectors.

CEREAL AND FORAGE INSECT INVESTIGATIONS

INSECTS ATTACKING CORN

The European corn borer increased in abundance in 1935 in Ohio, Michigan, and Indiana in the one-generation area, as compared with the numbers recorded during the drought periods since 1930. Apparently this was a result of the favorable climatic conditions that prevailed in 1935. Decided increases also occurred in parts of Connecticut, New Jersey, and Long Island in the multiple-generation area. The average numbers of borers per 100 plants for the areas where population studies were made on the one-generation strain in Michigan, Indiana, Ohio, and New York increased from 17.9 in 1934 to 31 in 1935. The average numbers of borers per 100 plants for the study areas in the multiple-generation area in Massachusetts, Rhode Island, Connecticut, and New York increased from 198.8 in 1934 to 360.3 in 1935. Damage continued to be severe in the New England market-corn areas. Evidence obtained in 1935 indicates the possibility of three generations annually on the Eastern Shore of Virginia. Approximately 160,000 parasites of oriental and European origin, primarily the ichneumonid wasp *Inareolata punctoria* Roman and the tachinid fly *Lydella stabulans grisescens* R. D., were liberated in 1935 in 60 areas in 11 States where liberation had not previously been made. In the fall of 1935 an attempt was made for the first time to secure parasites from domestic sources for carrying on the colonization program. Collections were made from the area in

the United States that had been longest colonized—around Boston, Mass.—and these provided adequate material for the releases of 1936, at a cost comparing very favorably with that of the foreign collections. Investigations to determine the relation of various corn characteristics to corn-borer resistance, including the testing of 136 inbred lines of field corn to determine their suitability for the development of resistant hybrids for commercial use, have been continued in cooperation with the Bureau of Plant Industry. While no plant characteristic other than delayed tassel eclosion has been isolated as associated with resistance, inbred lines of both field and sweet corn exhibited some resistance not associated with the appearance of the tassel. In field-plot and laboratory experiments in Connecticut the control values of selected insecticides and the comparative tolerances of the corn plant to them were determined. Results indicated that several insecticidal preparations withstood dilution, washing, and wind loss satisfactorily. Spray preparations found to provide a high rate of protection against infestation included nicotine tannate, ground derris, a high-dispersion nicotine bentonite, and phenothiazine. A dual-fixed nicotine consisting of nicotine tannate and nicotine bentonite was found to provide a very high rate of protection when applied in a dust form. A promising method of preparing nicotine tannate in a paste form which can be used in hard water has been developed and is being given field trials of its insecticidal value.

Investigations of the corn earworm have been continued in Virginia, Connecticut, Indiana, and Kansas, and work has been initiated during the year at Urbana, Ill. Extensive observations were made in Indiana on the relative susceptibility of various strains of field and sweet corn to earworm attack. Silking and infestation records were obtained on 2,282 plots of dent corn, including approximately 60 varieties, 202 hybrids, and 21 inbreds; and on 422 plots of sweet corn, including 20 varieties, 71 hybrids, and 18 strains which were being studied by the plant breeders for other characters. Although dependability of the results was reduced by the occurrence of a low infestation, a distinct and consistent difference in infestation between varieties was observed, over and above that due to silking date. There was some indication that the quality of resistance, apparently present in certain strains used as parents, was transmitted to the hybrid progeny. A series of 14 uniform experiments on hibernation of the earworm, distributed from the Atlantic seaboard west to Kansas, gave definite indications that the earworm, at least during the winters of 1934–35 and 1935–36, did not survive in significant numbers north of the thirty-ninth parallel and gives credence to the theory that the infestation in the Northern States results from migratory flights from southern areas.

Over 16,000 specimens of insects, belonging to approximately 65 species, collected on or near corn infected with Stewart's disease, have been cultured in an attempt to determine which of these species are responsible for transmitting the organism causing the disease. In 1935 three species of beetles yielded the causative organism and, in addition to the corn flea beetle, previously recognized as a carrier, the 12-spotted cucumber beetle gave positive evidence of being a carrier of the disease under field conditions.

Work on the southwestern corn borer in Arizona has been completed, it having been determined that barium fluosilicate can be used for the protection of especially valuable corn, and that the insect can be controlled under the agricultural conditions of Arizona through the proper application of cultural practices. A colony of 10,000 *Lydella stabulans grisescens*, a parasite of the European corn borer, was released in Arizona to test its effectiveness against the southwestern corn borer.

CORN INSECTS IN PUERTO RICO

Tests were made of various insecticides and of mechanical means for controlling the earworm in Puerto Rico. Certain mechanical methods gave excellent control at a cost considered low enough to permit practical use. Insecticidal methods, including tests with a number of insecticides, show that barium fluosilicate was the most effective under conditions of the tests but that this material was not so effective as the mechanical means utilized.

A study was made of the distribution, host plants, and life history of the fall armyworm under Puerto Rican conditions. Control studies indicated that some benefit could be derived from the application of 1–9 lead arsenate-lime dust and of barium fluosilicate. Both materials, however, resulted in some burning

to the plants and the methods cannot be generally recommended on the basis of present information. Observations indicated that it is not good practice to plant corn on newly plowed grassland because of the probable resultant heavy infestation.

Tests of the fungus *Sorosporella uvella* against both the fall armyworm and the corn earworm were unsuccessful in causing mortality.

Experiments in control of the corn leafhopper (*Peregrinus maidis* Ashm.) indicate that a nicotine dust is of value in reducing the abundance of this pest on particularly valuable corn plantings.

The ortalid fly *Euxesta stigmatias* Loew was found to be a primary invader of corn ears and of considerable importance as a corn pest. Infestations ranged from 28 to 92 percent. Although no special tests were made to devise control methods against this insect, some of the mechanical means utilized against the corn earworm materially reduced the maggot population.

INSECTS ATTACKING SMALL GRAINS

Although extremely heavy infestations of the hessian fly occurred over a considerable portion of the Wheat Belt in the fall of 1935 and caused much damage, the extremely dry conditions of the following spring and summer prevented serious damage from the spring brood and reduced the hessian fly population to a low ebb. Major emphasis in investigational work has been placed on a study of fly reaction to various varieties and strains of wheat, and, in cooperation with the plant breeders, on the discovery and development of resistant varieties. An attempt is being made to determine the fly reaction of all the major commercial varieties of wheat suitable for production under California, Kansas, and Indiana conditions. Seventy-five varieties were tested in California in the summer of 1935 and 300 varieties of authentic purities are now under test; 370 varieties, hybrids, and strains are being tested in Indiana and 375 in Kansas. A variety having almost complete immunity under California conditions has been discovered and has been successfully carried into the second and third back-crosses on commercially desirable club wheats. One variety of resistant spring wheat well suited to the soft-wheat region has been discovered at Lafayette, Ind., and five others have shown marked resistance and may be of value as fly-resistant parents in breeding work. In Kansas 13 strains have been found that have definite resistance, 4 of which have commercial value. Of 400 strains of spring wheat tested at Parsons, Kans., only 2, besides Marquillo hybrids, showed resistance to the fly. Certain strains which are resistant under California conditions have not retained resistance when grown in Indiana. Whether biological strains of the fly or difference in agronomic conditions are responsible for this variation is being investigated. Preliminary work indicates that soil factors are not involved and that similar variations occurring in Kansas probably cannot be explained on the basis of biological strains of the fly. It has been quite definitely proved that two factors are responsible for resistance in the California selection of Dawson, which has shown most promise, although indications are that different genetic factors may be involved in other varieties. Numerous colonies of six native and two European parasites of the hessian fly have been liberated in various locations in the United States where they do not now occur.

The black grain-stem sawfly (*Trachelus tabidus* F.) has continued to do much damage in western Pennsylvania and eastern Ohio, and the European parasite *Collyria calcitrator* Grav. has been released in both States. Colonies of a native parasite, *Pleurotropis benefica* Gahan, have also been liberated in Ohio, where it did not previously occur.

Winter mortality of the chinch bug was extremely heavy over most of the infested area and only scattered outbreaks have occurred in the area included in the 1934 epidemic. Some evidence of chinch bug resistance in wheat has been obtained and is being studied further. Studies on control of chinch bugs by eliminating small grains or by trapping them on barley, which is especially attractive, have shown that, while oats are the least attractive, the elimination from an area of all small grains except oats would not prevent chinch bug damage, although injury might be reduced to some extent. Even where all small grains are eliminated from an area, some infestations develop directly on corn, although a material reduction in the general infestation may result. No single small grain seems sufficiently more attractive than the others to serve effectively as a trap crop in which the bulk of the bugs in the neighborhood can be concentrated and destroyed.

INSECTS ATTACKING SUGARCANE AND RICE

Although the degree of infestation of sugarcane by the sugarcane borer was subnormal during 1935, a careful survey indicated that the loss for Louisiana due to this insect was approximately $1,400,000. Three years' experiments on the effectiveness of the egg parasite *Trichogramma minutum* in controlling the borer have been completed and the work has been discontinued. The results indicate that, contrary to statements widely made, this parasite is not effective in reducing the number of borer eggs present, in increasing the percentage of parasitization over that occurring naturally, or in increasing the total tonnage of cane or total yield of sugar. Importations of two parasites of the sugarcane borer that are of importance in controlling this pest under Puerto Rican and South American conditions have been made into the Florida and Louisiana cane sections, and a large colony of one of the effective European corn borer parasites was released in Louisiana for test against the sugarcane borer. Observations on relative susceptibility of cane varieties to borer attack have indicated that there is a consistent difference in degree of infestation between certain new varieties, and that the moths exhibit a preference for certain varieties for oviposition. Studies on the sugarcane borer as a pest of corn in Texas have indicated that certain varieties, such as Reese Drought-Resister, Surcropper, and Mexican June, are tolerant of borer attack under conditions occurring in eastern Texas. A valuable method of control through regulating the planting date of corn has been developed for this area. Complete control of the sugarcane borer in rice has been obtained through dragging and flooding the stubble.

Two new aphid vectors of the important mosaic disease of sugarcane have been discovered, and studies are under way to determine the relative importance of the various vectors and the relationship between their abundance and the presence of their wild hosts, and with the occurrence of ants which may be responsible for the distribution of the aphids.

It has been determined that the rice stinkbug (*Oebalus pugnax* F.) is responsible for a large proportion of the injury to the rice kernels known as "pecky rice", which resulted in an estimated loss to rice producers in 1935 of between $400,000 and $500,000. Other insects that have been tested have not been implicated as a cause of this condition.

SUGARCANE INSECTS IN PUERTO RICO

Investigations on vectors of sugarcane mosaic in Puerto Rico verified the fact that *Aphis maidis* Fitch is a very efficient vector of mosaic and confirmed preliminary results in the United States indicating that the aphid *Hysteroneura setariae* Thos. also transmits the disease. A sedge aphid, *Carolinaia cyperi* Ainslie, was definitely shown to be a very efficient vector of mosaic although it is not definitely proved that it is of importance in transmission in the field. The insect and its host, however, are very common around the canefields of the island and present at all times of the year. Evidence of ability to transmit the disease was also obtained with *Aphis nerii* Kalt. An improvement in the technique of transmission, which may be of value in other studies, was worked out in which seedling plants were used with distinct advantage over previous methods from the standpoint of convenience, ease of handling, and more rapid appearance of the mosaic symptoms. An extensive survey was made of the insects in and surrounding canefields that might be of importance in disease transmission.

INSECTS ATTACKING FORAGE CROPS

Low infestations by the alfalfa aphid have hampered the work in Kansas on aphid reaction to various varieties of alfalfa, but satisfactory progress has been made in California where resistant selections of alfalfa have been subjected to severe test; some of these have maintained immunity or a high degree of resistance and are being used as breeding stock. A study of climatic conditions governing aphid outbreaks in California has been completed. In Oregon, field plots of vetch and Austrian peas seeded after October 7 escaped infestation by aphids and were free of infestation as late as the following April. Regulating the planting date may afford a means of escaping commercial damage from these pests. A marked variation between vetch varieties in susceptibility to aphid attack was indicated by cage tests.

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Observations on early cutting as a control of the alfalfa weevil indicate that it is fairly successful in Utah and of considerable value in Oregon, but that apparently it would not be effective in western Colorado as it is now applied under conditions occurring this year. Conditions governing weevil development and its synchronization with cutting dates in Oregon and Colorado require additional study. Previously unknown infestations of the weevil have been discovered in Colorado, Oregon, South Dakota, and Nebraska. Detailed studies of this insect have been extended to western Nebraska and western Colorado, with a corresponding decrease in the work being conducted in the Great Basin.

The vetch bruchid (*Bruchus brachialis* Fahr.) has continued to do severe damage to the vetch seed crop in North Carolina. Its known distribution has been extended southward to include Georgia. Observations on a series of varieties of vetch planted under conditions of heavy bruchid populations indicate that both smooth and hairy vetch are heavily attacked, whereas Louisiana, common, narrow-leaf, and monantha vetches were attacked only lightly or not at all. Woolly-pod vetch was heavily infested with eggs, but serious larval infestation failed to develop.

Investigations of lygaeid plant bugs on the alfalfa seed crop in Arizona have indicated that above 70 percent of the flowers may be blasted as a result of high bug populations. Preliminary investigations have revealed the close relationship between the abundance of certain weeds and the production of high populations of this insect, and that heavy mortality of the bugs may result from properly timing the cutting of the hay crop with reference to adjacent seed crops.

Damage to alfalfa seed from pentatomid bugs ranges from approximately 1 to as high as 44 percent, the average injury in some areas being as high as 20 percent. Weed hosts are apparently important factors in developing large populations of these insects, and a possible reduction in damage through the timely destruction of such hosts is indicated.

The infestation of the range caterpillar in New Mexico was at a low ebb as a result of drought conditions and apparently offered a favorable opportunity to test the value of parasite releases for direct control. Over 5,000,000 egg parasites (*Anastatus semiflavidus* Gahan) of the range caterpillar were produced during the year at Tempe, Ariz., 1,000,000 being released in New Mexico in the spring of 1935 on restricted areas and 3,500,000 in the fall. A high percentage of parasitization, even where the parasite releases were confined to small areas, was not obtained. The results, however, were inconclusive, as dust storms seriously interfered with the spring releases and an unusually early snowfall came shortly after the release in the fall.

GRASSHOPPERS

During the summer of 1935 grasshoppers occurred in outbreak numbers in a number of Western and Middle Western States, but the outbreaks were much less intense than in 1934, owing to a considerable extent to the effective control campaign waged under Government funds in that year and partly to unfavorable climatic conditions for the development of the young grasshoppers. Control was necessary, particularly in the more severely infested northern Great Plains States, and the surplus left from the appropriation for grasshopper control in 1934 was utilized.

A very intensive grasshopper outbreak developed in the spring of 1936, concomitant with drought conditions, in Nebraska, Iowa, Kansas, Missouri, Oklahoma, Wyoming, Montana, northern Arkansas, and eastern Colorado, with minor infestations in certain other Western States. The occurrence of this outbreak was fairly accurately predicted in 1935 in the States covered by the cooperative annual fall grasshopper survey, which indicated the areas in which the most severe infestations could be expected. The survey did not include Arkansas, Missouri, and Oklahoma, where severe infestations developed. An appropriation of $250,000, made by Congress late in June, was utilized to its full extent in purchasing materials for poisoned bait to aid the infested States, but was far from adequate to meet the requirements. Infestations in the Middle Western States were accompanied by extensive flights, the indications being that such migrations had spread the infestation over areas not previously infested or only lightly so. The severe infestation to croplands has been accompanied by probably the most severe range-land infestation in recent years, particularly in Colorado, Wyoming, and Montana.

A program was perfected for studies to determine the cause of outbreaks of those species of grasshoppers prevalent on croplands and to develop methods of preventing them. This study includes the annual survey for prediction of outbreaks of cropland species, and the establishment of permanent study areas to determine the cause and methods of prevention of outbreaks and to improve the methods of survey to make the prediction of outbreaks more accurate under the diverse conditions occurring in various States for the dozen or more species of grasshoppers of economic importance.

Studies of baits have been continued. These are aimed at the development of a cheaper bait and one which would not compete with the feed market during periods of scarcity of livestock feed. These studies have indicated that molasses may be eliminated from the bait with little loss in effectiveness, and that sawdust covered with low-grade flour compares very favorably in effectiveness with the standard formula. Indications have also been obtained that the quantity of sodium arsenite can be reduced by one-half without materially affecting the killing power of the mixture. Further work with oil baits has indicated that certain species are not so readily killed by it as others. The demand still remains for a cheap, attractive bait that will remain effective for several weeks after distribution.

Observations on the effect of the range species of grasshoppers have indicated that large areas of grazing land were completely denuded by grasshopper attack, and that in considerable portions of the Montana area grazing conditions would have been greatly improved in spite of the drought had grasshoppers been absent. Studies are under way on the food habits and biology of the more important of the score or more species of grasshoppers that occur in abundance on range lands, and a study has been initiated to determine the possibility of preventing outbreaks on the range by controlling the grasshoppers in restricted areas during periods when their numbers are small.

MORMON CRICKET

Extensive outbreaks of the Mormon cricket occurred in Montana, Idaho, Wyoming, Nevada, and Utah. Assistance was given to the States in organizing control campaigns, and these were conducted under emergency funds. A test was made of airplane dusting for control of the Mormon cricket. The results were satisfactory as far as distribution of the dust was concerned but the mortalities obtained were low. The standard method of control by the use of hand dusters is more expensive than that in which baits are used and requires an excessive amount of labor. In the attempt to produce an attractive bait that will be effective in Mormon cricket control, a large number of materials have been tested without consistent results.

INSECTS ATTACKING STORED CEREALS

Investigations, by entomologists and chemists of the Bureau, of fumigants and fumigation for the control of insect pests of stored cereals have continued. The type of mill construction has a marked effect upon the efficiency of the fumigants. Mills of concrete and steel were found capable of holding killing concentrations of gas for at least 18 hours, as compared with only a few hours in the case of more poorly constructed mills.

Improvements have been made in the method of fumigating mills by piping hydrogen cyanide to the individual milling units. This method is giving a higher degree of control than could be obtained by the old methods and at a lower price and it is already being used by a number of mills. It has been tested with a methyl formate-carbon dioxide mixture in place of the liquid hydrocyanic acid, but it did not give satisfactory results in these cases, owing, apparently, to the slower action of this mixture. A study of the effect in mill fumigation of short exposures to hydrocyanic acid gas showed that the percentage of insects killed by the short exposures was nearly as high as for the longer exposures and indicated the possibility of using shorter fumigation periods with effective results in times of emergency.

Experiments to determine the behavior of some of the common grain fumigants in large storage bins and on the effect of methods of applying such fumigants demonstrated the dependence of dosage on commodity load, the need of introducing the gas at several points, and the advantage of forced circulation. Chloropicrin was found to give 100-percent kill of the adult rice weevil, one of the

most important pests of stored grain, and although it is disagreeable to handle it has some advantages over other commonly used fumigants. The application of fumigants to the top of the bin and at four levels when the bin was being filled with the ethylene oxide-solid carbon dioxide mixture was found to give an unsatisfactory kill.

An investigation of the fundamental principle underlying vacuum fumigation of cereal products in which the ethylene oxide-carbon dioxide mixture was used as the fumigant was initiated during the year at Cedar Rapids, Iowa. Results so far in this investigation have indicated that the quantity of gas required for successful results in the fumigation of rice and possibly other products depends upon the quantity to be fumigated rather than on the cubic feet of space. Recirculation of the fumigant in the vacuum tank adds greatly to its efficiency, reducing by 25 percent the dosage required when recirculation is not practiced. A carefully conducted series of experiments to determine the distribution of the fumigant in a vacuum chamber revealed that selective absorption takes place in the vicinity of the gas entry point and that multiple entry points give a more uniform distribution of the fumigant than only one. This improvement is now being utilized in commercial vacuum tanks.

A study of the sterilization of flour products by heat has indicated that bags of flour can be completely sterilized in 24 hours and that only a few hours are required for smaller bags, at vault temperatures of from 170° to 185° F. Preliminary results have also determined that a fan larger than that ordinarily used is necessary for effective circulation of the heated air in the vault and that best results can be obtained by attaching it near the ceiling. Tests also have indicated that forced circulation is of considerable value in raising the temperatures in the interstices between large bags in the vault.

Extensive observations have been made on the distribution and extent of infestation of various stored-product insects in mills in the Middle West and on the effectiveness of various commercial practices utilized in insect control.

EUROPEAN CORN BORER INSPECTION AND CERTIFICATION

INSPECTION AND CERTIFICATION

Federal inspection and certification continued with the personnel necessary to fulfill the quarantine requirements of States prescribing Federal rather than State certification as a requisite for admission of host material likely to spread the European corn borer. Inspectors covering large districts were stationed in Indianapolis, Ind., Detroit, Mich., and Toledo, Ohio. Inspections in territory jointly affected by Japanese beetle and/or gypsy moth restrictions were made by inspectors working from numerous districts and suboffices in the overlapping areas.

For the second consecutive year there was an increase in the quantity of certificates issued in conformity with the respective State quarantine orders. Inspectors issued 22,133 certificates to authorize the movement of commodities having an estimated value of $165,293. General improvement in the nursery trade, with a greater movement of dahlia roots, accounted for much of this increase.

State corn borer quarantines or orders remained unchanged during the year. Federal inspection continued as a requirement for the entry of restricted commodities into Arizona, California, Colorado, Georgia, Louisiana, Nevada, Oregon, Texas, and Utah. Wyoming maintained its embargo against the entry of host material from the infested States.

STATE COMPULSORY CLEAN-UP ACTIVITIES

Working under the direction of the Wisconsin Department of Agriculture, farmers in that State cleaned up fields that Works Progress Administration scouts working under State supervision had found infested with the corn borer during the summer of 1935. The farmers were paid $2 per acre for cleaning up their infested fields. This work, performed in addition to the regular cultural practices, consisted of picking up and burning all pieces of cornstalks remaining above ground after the field had been cultivated and seeded to small grain or corn.

Connecticut State legislation passed just prior to this fiscal year advanced from April 10 to 25 the date for conclusion of compulsory clean-up measures requiring the disposal of cornstalks, weeds, or other debris infested or likely to be infested with the corn borer. Reports indicate that the 1935 damage to early and late sweet corn in Fairfield and New Haven Counties, Conn., exceeded that of the previous year, although the borer population was somewhat reduced in the northern Hartford County farming district.

SCOUTING AND SURVEY ACTIVITIES ON RELIEF FUNDS

Late in July an allotment of $116,000 was made available by the Works Progress Administration for a survey to determine the degree of infestation in the area known to be infested with the European corn borer, and for scouting to determine whether the insect had spread to areas not previously known to be infested.

Since the season during which these activities could be performed was rapidly nearing a close, the work was organized as quickly as possible, using the permanent corn borer inspectors as a nucleus for recruiting the relief workers, who had to be contacted through the offices of the National Reemployment Service in the respective counties where the work was performed. Less than 5 percent of the total personnel came under the nonrelief exemption, although a 10-percent exemption was allowable.

Work was started in Massachusetts on August 7, and within a short time men were in the field in all of the New England States and in Delaware, Indiana, Maryland, Michigan, New Jersey, New York, Pennsylvania, Virginia, and Wisconsin. In Ohio the first crew was started on September 26. Scouting was also scheduled in Kentucky and West Virginia, but crews could not be organized in these two States until too late in the season for effective scouting, so no work was performed there. Generally the scouts and survey workers were employed for a period of 50 working days.

As finally organized, the usual set-up comprised a crew of four men in a county, with one of the men designated as foreman; a supervisor responsible for the work of the crews in five or more counties; and a regular corn borer inspector of the Bureau directing the operations of several of these county groups in one or more States. Seven appointed men of the Bureau served in this supervisory capacity. At the peak of the scouting and survey activities 432 Works Progress Administration workers were employed.

Scouting was performed in areas adjacent to or within a reasonable distance from areas known to be infested. All insect larvae resembling the European corn borer were sent to the field headquarters for determination. The supervisors were advised of any positive finds so that the crews might be immediately transferred to another township. If results were negative, a crew continued its activities in the township until 5 days of actual scouting had been completed.

As a result of the season's scouting, first-record infestations were found in 31 towns in Connecticut, 4 townships in Indiana, 21 towns in Maine, 28 townships in Michigan, 91 in New Jersey, 4 in Pennsylvania, 2 magisterial districts in Virginia, and 42 townships in Wisconsin. Scouting by men employed by the Wisconsin Department of Agriculture added 14 townships to those in which initial infestations were found in that State. Scouts covered sections of Delaware, Illinois, and Maryland with negative results. Scouting data were published in pamphlet form and distributed to interested State and Federal officials throughout the United States. The 1935 scouting was the first large-scale activity of this nature since corn borer scouting was abandoned after completion of summer activities in 1932.

Surveys to determine the concentration of borers were conducted in Michigan, New Jersey, New York, Ohio, Virginia, and each of the New England States. The activities extended to 1,124 townships or other political subdivisions in 69 counties. A total of 5,817 fields containing approximately 32,600 acres of corn were examined for corn borers.

In general, the survey was made in fields selected at random in each township of the counties covered. Twenty-five consecutive corn plants in one row near the center of each quarter of the field were examined for infestation, a total of 100 plants being examined in each field. Ten of the plants showing infestation were dissected to determine the average number of corn borers per infested plant.

BLACK STEM RUST QUARANTINE ENFORCEMENT

Under the regulations of the black stem rust quarantine, nurserymen who grow only rust-resistant species of barberry and *Mahonia* plants, as determined by inspection, may be granted permits for shipping to the grain-growing States of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. Such permits, however, are not required to authorize shipment of *Berberis thunbergii*, the Japanese barberry, and its rust-immune varieties. During the year permits were granted to 25 growers and to 1 dealer.

The Bureau has available for distribution lists showing (1) barberries which may be shipped interstate without permit and (2) *Berberis* and *Mahonia* species or varieties which are sufficiently resistant to black stem rust for shipment into the protected States. Barberry and *Mahonia* plants of species and varieties not shown in such lists are prohibited shipment into the protected States, or from any protected State to any other protected State, and permits will not be issued for such shipment.

Transit inspectors intercepted 12 shipments which had been consigned during the year in apparent violation of the quarantine.

BARBERRY ERADICATION

During the fiscal year 1936 more than 33,000,000 rust-spreading barberry bushes were destroyed on 8,470 properties in the 17 States of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, Pennsylvania, South Dakota, Virginia, West Virginia, Wisconsin, and Wyoming. Control work was conducted on approximately 50,000 square miles in 278 counties. In addition to the expansion of field operations in the 13 States of the original control area, allotments of emergency funds made possible similar work in some of the important grain-growing areas of Missouri, Pennsylvania, Virginia, and West Virginia.

Regular Bureau personnel, in addition to providing general supervision in connection with the emergency program, continued (1) the annual rust studies, (2) the classification and nursery inspection work required in connection with the enforcement of the stem rust quarantine, and (3) the necessary educational work in advance of eradication crews.

From July 22, 1935, to June 30, 1936, an average of 2,265 men were employed with emergency funds. Maximum employment was reached in June 1936, when a total of 4,121 men were at work. Ninety-four percent of all men employed were taken from relief rolls and 87 percent of all funds expended were used for salaries and wages. Those in the superintendence class, whose salaries were paid from emergency funds, varied from 60 in February to 140 in June.

SELECTION OF TERRITORY AND SURVEY PROCEDURE

In parts of Illinois, Minnesota, Iowa, Wisconsin, Colorado, Indiana, Michigan, and Ohio it has been found necessary to survey entire counties intensively in order to establish boundaries of barberry infestations. In Virginia, West Virginia, and Pennsylvania control effort has been restricted to those counties in which small grains are an important cash or feed crop, and damage caused by rust in recent years has been unusually severe. Laborers employed with emergency funds were found particularly useful in applying control measures in these extensive areas of infestation.

In some of the Western States, including the Dakotas, Nebraska, Wyoming, and Montana, survey work during the past year was conducted largely in timbered areas in communities where frequent local spreads of rust during past years have indicated possible local sources of infection.

Table 16 summarizes (by States) the progress that has been made in the eradication of barberry bushes during the year.

TABLE 16.—*Progress in barberry eradication during the fiscal year 1936*

State	Properties cleared of bushes	Barberry bushes destroyed	Territory surveyed	Security-wage earners		Proportion of all personnel taken from relief
				Maximum employed	Employment	
	Number	*Number*	*Square miles*	*Number*	*Man-hours*	*Percent*
Colorado	103	1,368,272	688	120	108,471.00	94.0
Illinois	703	7,070	4,980	303	230,747.50	93.5
Indiana	345	13,123	5,220	207	159,814.50	92.0
Iowa	588	17,439	5,100	294	211,149.25	92.0
Michigan	976	105,541	8,822	478	249,374.25	97.0
Minnesota	576	11,756	2,714	331	324,026.08	95.0
Montana	38	641	99	63	26,787.50	93.5
Nebraska	104	338	4,546	190	120,683.25	92.8
North Dakota	29	3,590	282	96	43,575.75	92.8
Ohio	1,150	228,232	6,038	359	305,184.00	94.6
South Dakota	26	854	1,298	52	25,391.00	90.4
Wisconsin	779	40,775	5,469	383	331,419.50	92.4
Wyoming	0	8	572	22	9,330.00	91.9
Total	5,417	1,797,639	45,828	2,898	2,145,953.58	----------
Missouri [1]	529	7,297	2,758	198	118,303.00	94.0
Pennsylvania [1]	1,553	917,878	1,064	310	160,858.25	95.3
Virginia [1]	593	23,784,570	260	465	211,962.75	94.2
West Virginia [1]	378	6,609,250	106	346	185,777.00	97.0
Total [1]	3,053	31,318,995	4,188	1,319	676,901.00	----------
Grand total	8,470	33,116,634	50,016	4,217	2,822,854.58	----------

[1] Results in these 4 States are shown separately in order that information relating to the original control area may be compared with previous reports.

RUST SURVEYS

Losses from stem rust in 1935 were greater than during any year since 1916. Stem rust overwintered rather extensively in certain parts of Texas during the winter of 1934–35. In the spring many of the barberries remaining within the control areas became badly rusted. Owing to excessive rainfall in the northern part of Texas during May, grain was late and stands were heavy, with the result that an unusually large amount of rust developed on winter wheat and later spread to Kansas and Nebraska. During the latter part of June strong winds followed by several weeks of warm, moist weather, ideal for the development of rust, resulted in an epidemic of the disease which extended from Texas northward to the Canadian border. The greatest damage occurred in parts of Kansas and Nebraska and in eastern South Dakota, western Minnesota, and North Dakota.

Losses to wheat from stem rust in the 17 States of the control area in 1935, as determined from weighing and carefully studying samples of grain collected during the course of rust surveys, amounted to approximately 102,054,000 bushels. Barley was damaged to the extent of 8,909,000 bushels, and losses to oats amounted to 3,523,000 bushels.

Extensive observations were made on the movement of rust from south to north as the season advanced. Spore traps were exposed at 31 stations throughout the Mississippi Valley. Approximately 600 slides were examined microscopically in order to determine when and where the principal movement of spores occurred. After the epidemic was well under way (late in July) it was found that urediospores of stem rust were being deposited in many localities at the rate of a million per square foot during a 24-hour period. The problem of obtaining as accurate an estimate as possible of the damage caused by the disease during the latter part of the season was complicated by the fact that extremely hot weather also contributed materially to the shriveling of the grain.

There is evidence that the epidemic of 1935 which extended over northern Kansas, Nebraska, the Dakotas, Minnesota, and the eastern parts of Colorado, Wyoming, and Montana developed primarily as a result of wind-blown inoculum

from Texas and other southern States. A combination of late crops in the winter-wheat area and delayed development of spring wheat in the Dakotas and Minnesota resulted in conditions ideal for the development of the epidemic, whereas in the normal year inoculum from the South reaches the spring-wheat area too late to cause serious damage.

During the year greenhouse studies were made of more than 900 collections of rust from barberries and wheat. Eighty-six percent of the barberry collections proved to be of the wheat variety of rust, and 26 different physiologic forms of stem rust were represented, as many as 8 distinct forms being obtained from a single collection. A new form was found in every 7 collections from barberry, while a different form was isolated from each 72 collections from grain. This confirms previous observations that the barberry is responsible for the persistence of many forms of the fungus that appear not to thrive in the Southern States.

RUST-SUSCEPTIBILITY TESTS

Forty specimens of barberries were tested under greenhouse conditions for reaction to stem rust, with the result that several species heretofore considered doubtful were placed in the proper class with respect to rust reaction. Further studies of the ecology of the barberry were made for the purpose of better understanding the natural increase in the field. The effect of temperature and various stimulants on the germination of the seed was studied. Under natural conditions it was found that most of the barberry seed germinated the first year but some remained dormant and continued to germinate for at least 4 years. It was definitely established that common salt, generally used for eradicating bushes, does not kill seed lying on the ground.

Forty new species and hybrids of *Berberis* have been added to the approximately 160 species now growing in the experimental plots in the foreign-plant introduction garden at Bell, Md. During April of this year the entire collection was again tested for rust susceptibility. Weather conditions were such, however, that the test was not as successful as those conducted in 1934 and 1935.

BARBERRY CLASSIFICATION AND NURSERY INSPECTION WORK

As a result of applications received by the Division of Domestic Plant Quarantines, 23 nurseries were inspected and authorized to ship immune species of barberries into protected States. Approximately 4,200 susceptible barberries were eradicated as a result of this inspection and educational work. During the year 140 specimens of barberry were sent in by State leaders in barberry eradication, State nursery inspectors, and nurserymen for identification as to species and reaction to the rust fungus. The classification work is carried on in cooperation with the Arnold Arboretum, Jamaica Plain, Mass.

EDUCATIONAL ACTIVITIES

In recent years there has been a constant demand for specimens and literature relating to the barberry-eradication program suitable for classroom use in connection with the teaching of nature study, biology, and agriculture. Renewed interest in stem rust control, brought about as a result of the expansion of field work with emergency funds, and the severe damage resulting from rust in many States during 1935, has resulted in a noticeable increase in the number of inquiries concerning control measures reaching both State and Federal offices. The demand has been met by making available to property owners circulars explaining the nature and purpose of the program, placing demonstrations at county and community fairs, and by supplying public-school teachers with specimens of rusted grain and barberry leaves, as well as literature suitable for classroom and laboratory study.

An attempt has been made to do some educational work in advance of eradication crews, and, through the various educational means employed, to obtain leads to localities infested with barberry bushes. The primary purpose of the educational work has been to stimulate sufficient local interest in the program to result in voluntary action on the part of property owners in preventing reinfestations in communities where control has been largely accomplished and to locate undiscovered areas in which barberries have escaped from cultivation.

Although during the year trained personnel have given practically their entire attention to the direction and supervision of laborers employed with emergency

funds, a total of 25 demonstrations were presented before 532 school and adult groups in 135 counties. Frequent use was made of local newspapers in communities where field work was conducted.

Table 17 summarizes results of informational work (by States) during the period July 1, 1928, to June 30, 1936.

TABLE 17.—*Summary of results of informational work on barberry eradication, by States, July 1, 1928, to June 30, 1936*

State	Counties completed [1]	Demonstrations given			Total attendance	Total properties reported	Total bushes reported
		Grade schools	All schools	Schools and other organizations			
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Colorado	15	757	907	911	27,705	34	306
Illinois	16	2,348	2,485	2,540	57,562	352	460
Indiana	6	1,021	1,699	1,764	234,211	159	795
Iowa	28	3,659	4,375	4,493	472,868	838	79,311
Michigan	5	2,945	3,319	3,372	594,686	773	7,101
Minnesota	32	3,802	4,109	4,620	179,223	564	3,425
Missouri	0	0	0	2	825	0	0
Montana	18	1,971	2,067	2,075	54,314	36	114
Nebraska	14	2,116	2,275	2,321	51,425	102	1,439
North Dakota	17	3,425	3,727	3,749	89,077	27	222
Ohio	2	419	530	551	23,124	108	2,726
South Dakota	18	1,555	1,723	1,802	78,074	41	114
Wisconsin	2	286	300	318	7,527	106	276
Wyoming	3	423	471	482	11,048	9	45
Total	176	24,727	27,987	29,000	1,881,669	3,149	96,334

[1] Number of counties in each State in which all schools have been reached with illustrated lectures pertaining to methods of reducing losses from stem rust.

VALUE OF INCREASED ACTIVITY IN STEM RUST CONTROL

The wide fluctuations from year to year in the yield and quality of small grains caused by the stem rust disease is generally recognized as one of the greatest hazards faced by farmers who rely largely upon the production of wheat, oats, barley, and rye for their cash income. In many localities throughout the control area the disease is a limiting factor in the profitable production of these crops. The 1½ billion bushels of grain produced on an average on the 50 million acres harvested each year in the 17 States participating in the control work had an average annual value of more than 750 million dollars. Naturally a plant disease which may seriously affect quality and may cut yields in half during the period of 2 or 3 weeks just prior to harvest is of major economic importance. Processors and consumers as well as farmers are affected by the severe economic losses experienced during those years when widespread destructive epidemics occur.

It is estimated that the use of emergency funds during the past year has put the barberry eradication program from 8 to 10 years ahead of what it would have been if the increased field activity had not been authorized. The expanded program (1) has provided additional insurance to farmers against sudden reductions in yield and quality of grain crops caused by outbreaks of the stem rust disease and (2) has provided regular employment for an average of 2,265 men during the 11-month period.

TRUCK CROP AND GARDEN INSECT INVESTIGATIONS

WIREWORMS

In combating the various species of wireworms that occur in injurious numbers in the irrigated sections of the West and in the Gulf region practical field work has indicated the relative efficiency of soil fumigation with naphthalene, flooding at a period when the soil temperatures are high, drying out the soil through the withholding of irrigation water, trapping of wireworm adults,

and the practice of certain crop rotations that are detrimental to wireworm development.

In the course of several field experiments in the Northwest it was found that the incorporation into the soil of 800 pounds of crude naphthalene per acre while the land was being plowed, and during the prevalence of soil temperatures reaching 70° F. or higher, killed from approximately 95 to 99 percent of the wireworms. Better results were obtained with naphthalene fumigation in loam or sandy loam soils than in silt loam soils.

As an example of the effectiveness of soil flooding as a method of wireworm control under favorable conditions of soil temperature it may be stated that as a result of flooding one part of a potato field in the State of Washington for a period of 7 days after harvest 100 percent of the wireworms were killed. The flooded part of the field contained an average of approximately 20 wireworms per square foot before treatment. During the period of flooding in this field the soil temperatures at depths of 6, 12, and 18 inches, respectively, averaged approximately 73° F. The part of the field not flooded contained an average of 8 living wireworms per square foot.

That the drying out of soil through the withholding of irrigation water constitutes a practical method of reducing injury by wireworms in irrigated lands was demonstrated in the State of Washington in a typical field test wherein potatoes were planted in 1935 in a field following alfalfa that had been dried out during 1934. The drying-out process had reduced the wireworm population to an average of less than one per cubic foot. At the time of marketing the potato crop produced in this field, only 4 percent of the potatoes were classified as culls due to wireworm injury whereas, in an adjoining field which was not subject to a drying-out process prior to planting, the potato crop was damaged so severely by wireworms that it was not worth harvesting.

Both sweetclover and red clover were found unsatisfactory crops to use in rotations in infested fields where wireworms were numerous, since these crops provide very favorable conditions for the increase of the wireworm infestation, as contrasted with alfalfa, which provides unfavorable conditions for wireworm increase.

Subterranean applications of dilute solutions of dichlorethyl ether applied to trap rows of beans planted to attract the wireworms has given indications of exerting a marked control of these pests.

The Gulf wireworm increased in importance, particularly as a pest of potatoes, in Alabama and South Carolina. Field experiments indicated that damage by this pest may be reduced greatly by adopting crop rotations that will include sod and that will avoid the planting of potatoes in the same land during successive years. Promising results were obtained by trapping the adults under potato vines raked into windrows after harvest and then burning the vines underneath which the adults had congregated.

BEAN AND PEA INSECTS

The Mexican bean beetle continued to be the most important pest of beans in the United States and in widely separated parts of the infested area caused severe damage to beans not treated with insecticides. Field experiments with insecticides in Ohio and Virginia on beans grown for the green-bean market or for canning have demonstrated that this pest can be controlled at a minimum cost by applying sprays or dusts containing rotenone derived from derris or cube without danger of incurring harmful residues on the market product. Cryolite sprays also were effective, but the use of this material must be discontinued after the pods have formed in order to avoid the possibility of harmful residues on the harvested beans. It has been found necessary to discontinue recommending magnesium arsenate as a control for the Mexican bean beetle. During 1935 this insecticide caused severe burning of bean plants and was not so effective as insecticides containing rotenone or cryolite. Laboratory studies disclosed that the active ingredients of derris were adsorbed and translocated in treated plants in such a manner as to prevent extensive feeding of bean beetle larvae on foliage that developed on the plants after the insecticide had been applied. This residual effect of rotenone-containing insecticides had been observed previously under field conditions. Results in Colorado of tests on irrigated beans grown for the dry-bean market demonstrated that, based on increased yields and calculated financial returns, sprays containing cryolite provided the best control.

Intensification of the pea-canning industry in the Pacific Northwest, particularly in Washington and Oregon, emphasizes the need for determining

methods of pea-weevil control. The utilization of a border trap crop and the plowing under of these border plantings prior to the time the main plantings blossomed have given encouraging results in the control of this pest. Experiments indicated also that dust mixtures containing rotenone may be useful in the control of the pea weevil, particularly in crops of high-quality peas. Biological studies disclosed that in Idaho the pea weevil is unable to survive winter temperatures below approximately —20° F., thus indicating a limitation of its distribution as an economic pest.

The pea aphid caused heavy losses to pea growers in many of the major producing districts of the country, particularly in Wisconsin, New York, and Ohio. Encouraging results in the control of the pea aphid were obtained in 1935 with sprays containing derris, and special field experiments were conducted with derris sprays and derris dusts in California, Florida, and Virginia late in the winter and in the spring of 1936. The results of these field tests indicated that derris sprays were effective in controlling the pea aphid and that under favorable conditions insecticides containing rotenone, the active ingredient of derris and cubé, had a residual effect that protected the treated plants from severe damage for an extended period after treatment. In general it was determined that sprays or dusts containing nicotine have a more rapid action against the pea aphid than insecticides containing rotenone but that the latter have a much longer residual effect. This residual effect of rotenone-containing insecticides against the pea aphid as observed in field tests was substantiated by laboratory studies. Continued field work late in the spring of 1936 demonstrated that a derris dust containing a specially prepared spreading agent yielded results comparable to those from a derris spray, the dust being prepared by atomizing a sodium oleyl sulphate into the derris-dust mixture while it was being revolved in a steel-drum ball mixer.

Studies on the biology and control of the lima bean pod borer in California have shown that this pest can be controlled with cryolite, but before this material can be generally recommended to the grower the possibility of danger from residues will have to be determined. As a possible aid in control, parasites from the eastern part of the United States were liberated, during the spring of 1936, in California fields infested by the lima bean pod borer.

POD BORERS IN PUERTO RICO

Biological and control studies were made on three species of pod borers that commonly attack all types of edible beans in Puerto Rico and that have greatly handicapped the commercial production of these crops on the island. Tests with various compounds and dilutions of arsenicals, fluorine compounds, pyrethrum, derris, and organic thiocyanates indicated that fluorine compounds gave the best results but that the use of insecticides containing this element was likely to lead to the presence of harmful residues on the market product. Consequently none of the insecticides tested to date can be recommended for use against the pod borers. Biological studies disclosed that the varieties of beans characterized by relatively smooth pods were not infested by pod borers to so great an extent as varieties bearing pods covered by relatively heavy pubescence. Investigations are being continued to determine whether this feature may be used to advantage in the control of these pests. Field observations indicated that one of the species of pod borers was more numerous in beans when this crop was interplanted with corn than when it was grown alone. It appeared that the shade afforded by the corn exerted some influence in inducing a concentration of pod borer adults, since other fields of beans grown under directly comparable conditions, but not interplanted with corn or other companion crops, were found to be relatively free of infestation.

TOMATO INSECTS

The tomato pinworm has continued to be a serious pest in southern California, but biological studies have revealed possible ways of control. Such studies have also shown that contact insecticides, including nicotine sulphate or a light oil, have caused an appreciable mortality of the tomato pinworm in its leaf-mining stages. Stomach poisons, excepting those containing fluorine have given unsatisfactory results when directed against the larval stages. Extensive field studies have demonstrated that much of the damage from the tomato pinworm may be avoided by discontinuing the present practice of piling

infested remnants of previous tomato crops along the edges of the field when a new crop is being planted in adjacent or nearby land.

Limited biological studies on the tomato fruitworm (*Heliothis obsoleta* F.) have disclosed that most of the eggs of this pest of tomato fruits are deposited on the upper and lower surfaces of the tomato leaves, toward the outside edges of the plant. It seems possible that advantage may be taken of this feature and that a more satisfactory control of the tomato fruitworm may be obtained through the use of insecticides.

MISCELLANEOUS VEGETABLE INSECTS

Extensive experimental work in Mississippi has demonstrated that fumigation of seed sweetpotatoes with paradichlorobenzene, particularly in storage banks, is an effective method of ridding such seed of the sweetpotato weevil and does not injure the viability of the seed.

Laboratory toxicity tests conducted for the control of the vegetable weevil in Mississippi failed to disclose any nonarsenical insecticides of sufficient toxicity to this pest to warrant further experimentation.

In California the cleaning up of nightshade, the winter host plant of the pepper weevil, under the supervision of the State and county authorities, has proved of great value in reducing damage by this pest. To be effective, however, the clean-up must be thorough and extend over a wide area.

In preliminary steps having for their objective the control of mole crickets, biological studies of these pests have been stressed in Florida. Much information has been accumulated respecting their habits, with special reference to such features as may have a bearing upon control. A survey has been conducted in the Gulf Coast and Atlantic Coastal Plain regions to determine more definitely the distribution and abundance of each of the principal species of mole crickets, with the result that *Scapteriscus acletus* R. and H. was found to be the predominant species.

Tests with insecticides directed against the turnip aphid in Louisiana have shown that insecticides containing rotenone, with sulphur and talc as diluents, have in general been more effective in producing a satisfactory market product than insecticides containing nicotine.

Studies on the control of the principal species of worms affecting lettuce in Arizona demonstrated that under conditions existing in that section during the fall of 1935, dust mixtures containing cryolite, applied 3 days after the plants were thinned, gave good control of lettuce loopers (*Autographa* spp.), but none of the insecticides tested was effective against the beet armyworm, another common pest infesting lettuce in the Southwest.

During the course of investigations on the European earwig in the State of Washington, parasites of this pest imported from Europe were liberated in 17 localities under widely divergent environmental conditions. The parasites were recovered from eight of these localities and have indicated their ability to become established and possibly to be of some value in the control of the earwigs. Attempts have also been made to establish the parasite at Newport, R. I., where the European earwig has been a pest for many years. In tests with various bait ingredients it was shown that fish oil was superior to water, and that the broadcast method of bait application was more efficient than the spot method of applying bait to restricted areas where the earwig was known to be abundant.

MOLE CRICKETS IN PUERTO RICO

Studies on mole crickets in Puerto Rico indicated that these insects are very important economic pests on the island. Investigations in the field demonstrated that vegetable crops suffered the greatest degree of damage by mole crickets, principally because such crops are grown in sandy soils that provide a favorable environment for these insects. The efficiency of several mechanical, cultural, and chemical controls was investigated, and it was found that the most effective method of combating these pests consists of the application of a bait containing paris green and flour. This bait is being extensively employed by the growers of vegetables and tobacco on the island. Small-scale field tests indicated that white arsenic or sodium fluoride were superior to paris green as an ingredient of the bait. Moist piles of sand placed in infested fields during the dry season attracted large numbers of mole crickets and indicated the possibility of utilizing this feature as an aid to control.

ONION THRIPS IN PUERTO RICO

The profitable growing of onions in Puerto Rico has been restricted greatly during recent years on account of the damage caused by the onion thrips. This insect has constituted such a limiting factor in the production of onions that it has been necessary to import onions in order to obtain a sufficient supply for domestic use. It has been felt that if the onion thrips could be controlled, the production of onions could be increased sufficiently to meet domestic demands and possibly to provide for export to the United States during the winter season.

Preliminary tests with a nicotine sulphate spray, and with a naphthalene-hydrated lime dust mixture, both of which have been used successfully in combating the onion thrips in the United States, gave promising indications that these materials may prove useful in the control of this insect under Puerto Rican conditions. Encouraging results were also obtained in the tests with the more recently developed sprays containing rotenone, in combination with wetting agents and spreaders, and with a dust mixture composed of lime-free sulphur in combination with manganese dioxide.

COLE-CROP INSECTS

Experiments on the control of insects affecting cole crops have involved the treatment of large field plots of cabbage for the control of several species of cabbageworms as well as laboratory tests to determine the relative toxicity of pyrethrum, derris, cube, cryolite, the ground root of devil's shoestring (*Cracca virginiana* L.), calcium arsenate, and paris green.

On cabbage, derris dust mixtures were more effective against the imported cabbageworm than pyrethrum, cryolite, or calcium arsenate; derris and cryolite were approximately equal in effectiveness in controlling the cabbage looper, and both of these materials were more effective than paris green, pyrethrum, or calcium arsenate; while derris and calcium arsenate were approximately equal in effectiveness in controlling the larvae of the diamond-back moth and more effective against this species than pyrethrum, cryolite, or paris green. Experiments in California demonstrated that dust mixtures of derris, cube, or pyrethrum gave satisfactory results in the control of the three more common species of cabbageworms on cauliflower.

In laboratory tests the ground root of devil's shoestring, a domestic product, was found to be as effective against the common species of cabbageworms as derris or cube containing equal percentages of active ingredients. During the fall of 1935 the corn earworm and several species of cutworms were destructive to cabbage in several plantings in the Charleston, S. C., district, but the derris dusts used for the control of the ordinary species of worms attacking cabbage were not effective against these noctuids.

BERRY INSECTS

Investigations directed against the strawberry weevil in North Carolina have shown that the most satisfactory material for reducing the number of weevil-cut buds on the strawberry plant consists of a mixture of calcium arsenate and sulphur. Nonarsenical insecticides proved to be less effective, although dust mixtures containing rotenone resulted in the production of larger quantities of marketable fruit than any of the other insecticides tested. These experiments disclosed that the application of the calcium arsenate-sulphur mixture, while it greatly reduced the number of weevil-cut buds, apparently caused some injury to the plant which resulted in a decrease in the production of marketable fruit.

Biological and control studies on the strawberry root aphid in North Carolina indicated that damage by this pest may be avoided to a great extent by selecting fields for strawberry planting that have received fall cultivation and that are distant from crabgrass and other favored host vegetation of the cornfield ant, which is the attendant of the strawberry root aphid.

Large-scale tests directed against the raspberry fruitworm in the Puyallup Valley of Washington showed that two sprays of lead arsenate applied to the plants prior to blooming, followed immediately after the blooming period by one spray containing derris root, gave a satisfactory commercial control of the raspberry fruitworm and produced fruit free of arsenical residues.

Promising results were obtained in the control of the red berry mite (*Eriophyes essigi* Hassan) in the Puyallup Valley of Washington by applying lime-sulphur sprays during the dormant period of the plant, followed by sprays containing wettable sulphur or emulsions of refined petroleum or coal-tar oil, during the growth of the plants and up to the time when the fruit begins to ripen.

BEET LEAFHOPPER

In the southern Idaho beet-growing area early-season indications were that light infestation by the beet leafhopper could be expected. This prospect was borne out, but the small number of the insects from the wild-land breeding areas that entered the cultivated fields did not do so until later in the season than normally. Consequently this pest did not seriously affect production of beets in this section. Progress was made in outlining and mapping the critical breeding areas of the leafhopper. Previously obtained evidence was substantiated to the effect that, if given an ample opportunity, the native grasses which are not hosts of the leafhopper will replace, through proper land-utilization methods, the introduced weed hosts of the leafhopper in the desert breeding areas and in abandoned areas that have formerly been under cultivation. Work was continued in California, in cooperation with State workers and sugar companies, on the spraying of desert host plants upon which the leafhopper congregates during certain seasons and in the elimination of Russian-thistle, a favorite wild host plant of this insect. The evidence so far indicates that these control methods are of direct benefit in reducing the damage caused by leafhoppers and the curly top disease of which they are the vectors.

Experiments on the control of the beet leafhopper on sugar beets grown for seed in Arizona, New Mexico, and Texas, in cooperation with the beet-seed producers, demonstrated that two different pyrethrum extract-oil combinations applied in an atomized form to sugar-beet seed plants and directed against the adults or nymphs of the beet leafhopper killed an average of approximately 95 percent of the leafhoppers present. Emphasis during the past season has been placed on the relation of leafhopper movements in southern Idaho to curly top injury to beans and tomatoes.

TOBACCO INSECTS

Experiments in Florida and Tennessee disclosed that a derris or cube dust mixture containing 1 percent of rotenone was effective in controlling the tobacco flea beetle in the plant bed as well as on newly set plants and on the growing crop. Tests with different diluents for the derris or cube root powder indicated that sterilized tobacco dust was the most suitable for this purpose and did not leave unsightly deposits on the harvested plants.

In laboratory and field experiments in Florida and Tennessee designed to determine a satisfactory substitute for lead arsenate or paris green for the control of tobacco hornworms, many different types and dilutions of insecticides, including standard insecticides as well as some of the more recently developed materials, were tested. No promising substitute for arsenical compounds has been found, but field experiments demonstrated that dust mixtures of paris green and hydrated lime, when applied properly, gave effective control of the hornworms and reduced to a minimum the degree of injury to the plants and the quantity of objectionable residues on the harvested product.

Continued control work in Florida and Georgia against the tobacco budworm demonstrated that under commercial conditions this pest could be controlled successfully with a properly applied bait composed of lead arsenate and corn meal. No success was obtained in attempts to substitute a cheaper carrier for corn meal in the budworm bait.

Field and laboratory tests in Florida with various insecticides directed against the tobacco thrips yielded inconclusive results.

Under conditions of light infestation in Kentucky and Tennessee, a poisoned bait containing paris green, corn meal, and oil of mirbane gave good control of the tobacco webworm (*Crambus caliginosellus* Clem.), when applied soon after the plants were set in the field.

A survey of the areas in North Carolina, South Carolina, and Virginia where tobacco for flue curing is produced disclosed that the principal pests affecting tobacco in those areas were flea beetles, hornworms, and budworms. Studies on the control of these pests in these areas were initiated during the

year. Studies were also initiated in Connecticut with special reference to the control of the flea beetles attacking tobacco in that section.

The work in Virginia on the cigarette beetle and tobacco moth as pests of stored tobacco has been directed primarily along control lines. The utilization of a light trap in warehouses combined with hydrocyanic acid gas fumigation has resulted in a decided reduction in the quantity of stored tobacco destroyed by these two pests. Promising results have been obtained in preliminary tests with pyrethrum-dust mixtures directed against the adults of the tobacco moth in storage warehouses of the closed type.

GREENHOUSE AND BULB INSECTS

In continuing work with the gladiolus thrips in Maryland, greenhouse experiments show that sprays containing rotenone are not so valuable as paris green-sugar mixtures for controlling this pest, but no foliage injury accompanies such treatments.

As a result of observations conducted in South Carolina on the insect vectors of the azalea flower spot disease, in cooperation with the Bureau of Plant Industry, it was shown that several species of bees were responsible for the dissemination of the organism causing the disease. These findings corroborate the tentative conclusions reached in the investigations performed on this project in 1934 and 1935. Additional information was obtained respecting possible methods of controlling the insect vectors.

Tests against red spider mites and thrips on greenhouse-grown cucumbers and tomatoes in Ohio indicated that these destructive pests are partially controlled wtih sprays containing rotenone or with sprays containing organic thiocyanates, when properly applied in conjunction with suitable spreaders and wetting agents.

Cooperative tests with State workers in North Carolina demonstrated that the bulb mite on tuberose bulbs can be controlled under commercial conditions by treatment with hot water, without injury to the treated bulbs. Further indications were that best results are obtained when the bulbs are planted either on newly cleared land or on soil that has been in cultivation but on which tuberoses have not been grown during the previous season.

MUSHROOM INSECTS AND MITES

Studies on the control of mushroom pests have been continued in experimental mushroom houses at Beltsville, Md., and, in cooperation with mushroom growers, in Pennsylvania. Control experiments with the fumigants naphthalene and paradichlorbenzene indicated that the former was not very toxic to the mushroom fly and was injurious to mushrooms and spawn, whereas the latter fumigant gave promise in the control of insects and mites in bearing mushroom houses and did not appreciably injure the mushrooms or spawn.

COTTON INSECT INVESTIGATION

During May 1936 a new laboratory for cotton insect investigations was established by the transfer of two entomologists from Tallulah, La., to the Georgia Coastal Plain Experiment Station at Tifton, Ga. This laboratory was established to conduct studies on the control of the boll weevil and other cotton insects in a region where little attention has been given to this subject for many years. The studies will be carried on cooperatively with the State experiment station and should develop a program of cotton insect control suitable and practical for the southern coastal plain area.

BOLL WEEVIL

In the spring of 1935 boll weevil emergence from hibernation was lower than normal at all stations where hibernation studies are conducted, but was higher in South Carolina than at stations in Louisiana, Texas, and Oklahoma. During May and June in many areas conditions were so favorable for the weevils that the prospects for heavy damage were serious. Midsummer weather conditions, however, checked the weevils so that no control measures were used on most farms. The heaviest damage occurred in Georgia and South Carolina. In

August and September large areas of cotton in Texas, Oklahoma, Louisiana, and Arkansas were dusted with calcium arsenate to control the cotton leaf worm and the bollworm, and some control of the boll weevil was obtained at the same time.

At Tallulah, La., the early boll weevil infestation was fairly heavy in May and June of 1935, but the hot, dry weather during July and August gave such natural control of the weevils that the average increase in the 33 plots where calcium arsenate was applied for boll weevil control was only 153 pounds of seed cotton per acre, or 11.3 percent, as compared to 236 pounds, or 19.5 percent, in 1934 and 419 pounds, or 45.4 percent, in 1933. In the large series of cage and field tests conducted to determine the efficacy of various insecticides and mixtures of insecticides none was found that gave better results than calcium arsenate. As in previous years, the early morning applications of dust gave the best results, with the evening applications taking second place and the midday applications third, but the differences were not striking and indicate the possibility of boll weevil control by the proper application of calcium arsenate dust at any time of the day. In spite of the fact that in cage toxicity tests, and also as measured by the reduction of infestations in field tests, mixtures of 75 percent of calcium arsenate and 25 percent of paris green and of 90 percent of calcium arsenate and 10 percent of paris green gave better results against the boll weevil than calcium arsenate alone, the yields of cotton were greater in the plots dusted solely with calcium arsenate. These results are in agreement with tests made in previous years. In an extensive series of cage and field tests a mixture of derris and sulphur containing 1 percent of rotenone, a mixture of 1 part of phenothiazine to 9 parts of sulphur, and a mixture of equal parts of lime and calcium arsenate were used, but in neither cage nor field tests did any of these compare favorably for boll weevil control with calcium arsenate used alone.

On the light, sandy soils of the Atlantic coastal region in the vicinity of Florence, S. C., in 1935, boll weevil infestation was rather light and the most profitable returns in control, among seven methods tested, were obtained by dusting with a mixture of 1 part of calcium arsenate and 2 parts of hydrated lime after the infestation had reached 10 percent. Next best was dusting with a mixture of equal parts of calcium arsenate and hydrated lime, a measure that had ranked first during several previous seasons; third best was dusting with calcium arsenate alone; and fourth was mopping during the presquare stage with the molasses-calcium arsenate mixture, followed by the application of calcium arsenate dust after 10-percent infestation had been reached. The fact that the mixture of lime and calcium arsenate has been effective in controlling the boll weevil under the conditions existing in the Atlantic coastal region is of special interest, as the use of the mixtures will to some extent offset the objectionable features that have developed in that region from the use of calcium arsenate alone. The lime mixtures reduce the danger of soil poisoning and of heavy aphid infestation and at the same time are more economical. The addition of the lime to the calcium arsenate helps to prevent the growers from applying more than 3 to 5 pounds of calcium arsenate per acre per application. The tendency in past years has been for the growers to apply too much calcium arsenate, thereby increasing the cost of poisoning and also the danger of soil injury and aphid infestations.

Under the conditions prevailing in Mississippi during 1935 the best results in the field-plot-control tests were obtained from one presquare application of calcium arsenate dust followed by later applications after 10-percent infestation had been reached. This was the only method that gave greater gains and larger profits than dusting with calcium arsenate after 10 percent of the squares had become infested. The advantage of presquare poisoning was shown by the fact that in the fields receiving this treatment the boll weevil infestation was delayed about 1 week in reaching a given intensity as compared with the untreated fields.

The winter of 1935–36 was especially severe on the boll weevil, as indicated by the fact that no live weevils were found in the spring of 1936 in Spanish-moss at Florence, S. C., and Tallulah, La., where many boll weevils are usually found during the spring examinations. In a large series of hibernation cages at Eufaula, Okla., no boll weevils survived, at Florence the survival was lower than in any previous year of which we have record, and at Tallulah it was much below normal. Only in Texas were conditions favorable for high survival; at College Station and Port Lavaca, Tex., the weevils were more abund-

ant than usual early in the spring. In spite of the low survival in hibernation cages and in Spanish-moss, in Louisiana and South Carolina boll weevils were found under the leaves and trash in the woods close to cotton fields. In the vicinity of Tallulah, an average of 141 live weevils per acre were found under leaves and trash within 100 yards of cotton fields, while at Florence, where the collections were made within 50 yards of the edge of the woods, an average of 311 live weevils per acre were found. These studies indicate the importance in any boll weevil control program of giving special attention to the destruction of overwintering weevils on the surface of the soil in protected places near cotton fields.

A study of the characters of cotton that may be resistant to the boll weevil was made with many varieties during the season of 1935, in cooperation with the State experiment stations at Stoneville, Raymond, Natchez, Poplarville, and State College, Miss., and at St. Joseph and Baton Rouge, La. It was found that more cotton damaged and destroyed by weevils occurred among those varieties that had thin carpel coverings than among those that had thick coverings, although the damage among the latter extended to a greater age. Practically no boll weevil eggs were deposited in any variety at any location until squares became scarce. When 30 varieties were planted 2 months later than the normal planting time, the cottons bearing bolls with thick-walled carpels produced fewer bolls than those bearing bolls of the other type. In these experiments the percentage of cotton loss was greater on plants having bolls with thin carpel walls and tough linings than on those with bolls having thick carpel walls and less tough linings. According to commercial standards of grading and a technical color classification, the damaged cotton from bolls with thick walls had more brilliance damage and more discoloration than that from bolls with thin walls. When a very hairy and a very smooth variety of cotton were studied at Stoneville, Miss., in relation to the adherence of dusted calcium arsenate, it was found that the hairy variety retained more arsenic pentoxide under all like conditions, but this was especially the case when plants were dusted dry.

About 80 percent of all the boll weevil parasites reared in the different States have been *Microbracon mellitor* Say. Other species of importance are *Triaspis curculionis* Fitch, *Eurytoma tylodermatis* Ashm., *Catolaccus hunteri* Cwfd., *Zatropis incertus* Ashm., *Eupelmus cyaniceps amicus* Gir., and *Myiophasia globosa* Tns. Apparently about 6 percent of the boll weevil larvae are parasitized. Occasionally parasitization has run as high as 30 percent, and in a few areas it has remained as high as 20 percent throughout the season. Among the parasites introduced in the hope of obtaining one that might effectively control the pink bollworm there is one, *Microbracon kirkpatricki* Wilk., from Kenya Colony, Africa, that may prove of value against the boll weevil. It seems to be even more effective than the native parasite *M. mellitor*, as it lays more eggs and has a shorter life cycle.

SOIL INJURY FROM CALCIUM ARSENATE

The investigation of possible injury to soils by the extensive use of calcium arsenate for boll weevil control has been continued. At Tallulah, La., a field plot receiving calcium arsenate at the rate of 400 pounds per acre annually beginning in 1931 has now received a total of 2,000 pounds of calcium arsenate per acre and produced seed cotton during the 5-year period at the average rate of 1,778 pounds per acre as compared to 1,795 pounds in the untreated plot. On the other hand, there may be danger of injuring the soil for other crops by the use of excessive quantities of calcium arsenate, since soybeans and cowpeas planted on the treated soil soon died although they grew normally on the untreated soil.

In Mississippi an intensive study has been begun of the effect of calcium arsenate on seven of the major soil types and on the crops grown on them. Plots of each type of soil received calcium arsenate at the rate of 50, 100, 200, 400, 800, and 1,600 pounds per acre. The germination of cotton was not affected in any of the plots where less than 1,600 pounds of calcium arsenate per acre was used, but many of the seedling plants died on plots where calcium arsenate had been applied at the rate of 800 and 1,600 pounds per acre. The germination of corn was not affected in any of the plots, but many seedling plants died where applications of 400, 800, and 1,600 pounds of calcium arsenate per acre

101897—36——5

had been made. The arsenic in the soils had a more injurious effect on soybeans than on cotton and corn. The germination was fair but many plants died on the plots receiving 400, 800, and 1,600 pounds of calcium arsenate per acre, and on three of the seven soils soybeans were a complete failure where 1,600 pounds of calcium arsenate had been applied. The effect of excessive quantities of calcium arsenate varied considerably with the different soil types. On the four types of soil where field tests with cotton were conducted, only the Ruston soil at Poplarville, Miss., showed noticeable injury by applications of 200 pounds or more of calcium arsenate.

COTTON FLEA HOPPER

Dusting with sulphur for control of the cotton flea hopper continued to give profitable returns. Although weather conditions at Port Lavaca, Tex., during 1935 were very unfavorable and too much rain hindered the dusting program, 10 large-scale sulphur-dusting experiments averaging 34.1 treated acres per experiment made an average gain of 167.5 pounds of seed cotton and a net profit of $4.75 per acre. A mixture of 10 percent of paris green and 90 percent of sulphur gave a higher kill of the flea hopper than did sulphur alone—an outstanding result of the year. The average gain from three 1-acre plots dusted with two applications of 10-percent paris green-sulphur was 220 pounds of seed cotton per acre; the cost of treatment was $1.92 and the value of the increased production was $9.66, leaving a net profit of $7.74 per acre. A few preliminary experiments with a mixture of 20 percent of calcium arsenate and 80 percent of sulphur also showed to good advantage over sulphur alone. One field dusted only twice with this mixture produced a gain of 143 pounds of seed cotton per acre, as compared to a gain of 134 pounds from a comparable field dusted four times with sulphur alone. These field experiments are in line with results obtained during the last 3 years in cage toxicity tests in showing that while sulphur is very effective against the cotton flea hopper nymph, arsenicals are more effective against the adult. During the spring of 1936 approximately 20 percent more flea hoppers emerged in the hibernation cages than during the 2 preceding years. The emergence was 3 weeks later this year than in 1935 and, as many wild host plants were then present, the flea hopper infestation in cotton was later and lighter than usual. During April, May, and June 1936, 1,360 flea hoppers were caught on 12 screen traps located in different parts of Calhoun County, Tex., as compared to 3,814 during the same period of 1935, 7,423 in 1934, and 6,404 in 1933. As in 1934, nine generations of the cotton flea hopper occurred at Port Lavaca in 1935. In June 1936 two egg parasites of the cotton flea hopper were discovered. One species, *Anaphes anomocerus* Gir., had previously been reported as an egg parasite of another mirid, occurring on alfalfa in Utah, but the more abundant parasite is a new species of *Erythmelus*.

BOLLWORM

During the summer of 1935 there was a serious outbreak of bollworms in the cotton fields of the black lands and river bottoms of northeastern Texas. Thousands of acres of cotton were dusted with calcium arsenate and other arsenicals by various types of dusting machines, including a number of airplane dusters. It was impossible to determine the amount of damage caused by bollworms, as most of the cotton fields were at the same time seriously infested with cotton leaf worms, boll weevils, cotton flea hoppers, and other insects that were causing damage. In a series of tests with different methods of control none was found so profitable as the application of calcium arsenate at 4- or 5-day intervals from the time the worms made their appearance on cotton, the applications being continued as long as the worms were present. The fields receiving this treatment were dusted with calcium arsenate on an average of nine times. The number of applications ranged from 5 to 12, depending on the abundance of the bollworms on cotton and also on the number of times the calcium arsenate was washed off by rains. The plots receiving this treatment made an average gain of 450 pounds of seed cotton, or a profit of $15.46 per acre. During the fall of 1935 a disease that was widespread among the bollworms in that section of Texas killed most of them, and it is thought that those entering the soil to pupate must have died there, as no moths emerged in the hibernation cages during the spring of 1936.

PINK BOLLWORM

In the pink bollworm investigations special attention was given to the establishment of introduced parasites, the studies of varietal resistance, the factors influencing survival under field conditions, and control by cultural methods and insecticides.

Microbracon kirkpatricki appears to be the most promising of the parasites studied, and 122,000 of this species were liberated in Texas, Mexico, and Puerto Rico. Recoveries have been made in the fields where liberated, but establishment is still uncertain. Thirty-two thousand *Chelonus blackburni* Cameron, the egg parasite introduced from Hawaii, were reared on the Mediterranean flour moth and the Angoumois grain moth and released in the Presidio Valley of Texas and in Puerto Rico. The Hawaiian pink bollworm strain of *M. mellitor* was not reared in sufficient quantities for field release, but in hibernation tests a winter survival of 89 percent was recorded, and this species seems promising. In the Egyptian strain of *Exeristes roborator* F. the sexes were about equally divided, whereas the European corn borer strain produced a much greater number of males than females when reared on pink bollworm larvae.

Although no varietal resistance was found in the nine varieties of cotton tested, the tests indicated the importance of early maturity in reducing pink bollworm damage. Further experiments are being conducted along this line in connection with spacing tests and withdrawal of irrigation water early in the season to hasten maturity. Examination for overwintering larvae in soil under plants that had been stripped of all fruit at various intervals during the fall corroborated the reduction in the overwintering soil population from the early maturity and destruction of the cotton stalks. The number of worms found in the fields with heavy soil and rank growth of cotton was much greater than on the lighter soils. Survival and spring emergence of moths were again much less where the bolls and trash had been buried and irrigated early in the winter than they were where any other treatment had been applied.

Further improvements were made in the push-type tractor-operated stalk shaver and rake for cleaning fields.

From the more promising of the insecticides previously used, barium fluosilicate, cube, annd cube-sulphur mixtures were selected for additional field-plot tests. All of these gave some control, as indicated by a reduction of the number of worms per boll, but none was very effective or satisfactory.

HEMIPTEROUS INSECTS

Investigations were continued in Arizona on the seasonal abundance and importance of the hemipterous insects attacking cotton, their host-plant relationships, and the methods for their control. At least 15 species were found to affect cotton. The most important of the boll-feeding group are the pentatomid bugs *Euschistus impictiventris* Stål, *Chlorochroa sayi* Stål, and *Thyanta custator* F., while the mirids *Lygus hesperus* Knight and *Psallus seriatus* Reut. were the most injurious to squares. The fact that cotton is not the favorite food plant of any of the species studied complicates the problem. All of these insects migrate from other cultivated and wild host plants to cotton when these plants become unsuitable for food. Considerable variation in the amount of damage by the boll-feeding group was found in different districts of the State, ranging from 8 percent of the bolls punctured in Pima County to 43 percent in Yuma County, the average for the State being 27 percent. Cotton from punctured bolls is stained and discolored, and as a result the entire crop of cotton in the Buckeye Valley in 1935 was reduced at least a full grade in value. Studies to differentiate the damage caused by the various species were made by confining each species separately in cages with growing plants. Good gains in yields were secured in plots dusted with a number of insecticides, and further tests are needed to determine the most efficient insecticide and details of methods of application. Thirty percent of the bolls confined with *C. sayi* and 20 percent of those confined with field-collected *E. impictiventris* developed boll rot, while tests with the western cotton stainer (*Dysdercus mimulus* Hussey) have all resulted negatively.

ANIMAL FAUNA OF THE SOIL

In cooperation with the Bureau of Plant Industry, studies were continued on the effect on the soil fauna of heavy applications of green and barnyard manures applied for the control of cotton root rot. Periodic samplings from plots

that had been treated with manure for 10 years showed an increase in the number of soil animals, both of the root-feeding and saprophytic types, due to an increase in food supply and improvement in soil structure. The data indicate that the control of the root-rot fungus by manuring was brought about independently of the soil animals present.

THURBERIA WEEVIL

The droughts in Arizona during recent years have tended to reduce the numbers of the Thurberia weevil. Studies of this insect removed from *Thurberia* and bred exclusively on cotton for the last 9 years indicate that it is not likely to become a serious cotton pest under Arizona conditions. The danger of its spread into cotton-growing areas may be greatly reduced by the destruction of wild *Thurberia* plants in the areas adjacent to and draining into the cotton-growing districts.

WORK IN PUERTO RICO

The production of sea island cotton in Puerto Rico, once an important industry, has been discontinued in recent years, partly because of the damage caused by the pink bollworm. Studies of the causes of the heavy damage by this pest were begun in September 1935 to assist in the rehabilitation of cotton growing on the island. Special attention has been given to the host plants of the pink bollworm, to the formation of the long-cycle or resting-stage larvae, produced and continuing through the season when cotton is not available for breeding, and to the duration of this long-cycle stage. The wild cotton (plants escaped from cultivation) that grew abundantly in waste places and was the most important reservoir for the carry-over of larvae of the pink bollworm has now been almost completely eradicated by the Puerto Rico Emergency Relief Administration. The seed pods of the trees *Montezuma speciosissima* and *Thespesia populnea*, commonly used for ornamentals and roadside plantings, were found to be the most important alternate hosts, although other plants are attacked. The formation of resting-stage larvae which continue for several months was definitely established. A study of the climatic conditions and agronomic practices in the main cotton sections on the north and south coasts shows the feasibility of having uniform planting and closed-season dates for cotton in both areas. Colonies of the pink bollworm parasites *Exeristes roborator*, *Microbracon kirkpatricki*, and *Chelonus blackburni* were furnished by the Presidio, Tex., laboratory for liberation. Recoveries have been made in the field, although it is not definitely known if these parasites have become established.

Considerable information has been obtained on a number of other insect pests of cotton, some of which do not occur on the mainland.

PINK BOLLWORM CONTROL

The most outstanding development in the pink bollworm situation is the fact that no new infestations were found during the inspection of the 1935 crop; furthermore, there was no recurrence of the pest in several areas still under regulation. These areas include all of Georgia and Florida and that part of Texas and New Mexico is known as the western extension. As two crop seasons have elapsed since the original infestation was found in southern Georgia in the 1933 crop, this area has been released from quarantine restrictions. The area actually found to be infested in 1935 is smaller than at any time since the 1926 crop and is limited to the Rio Grande and Pecos Valleys of Texas and New Mexico and the Safford area of Arizona.

INSPECTIONS WITHIN REGULATED AREAS

Intensive gin-trash inspections were carried on in the regulated areas of southern Georgia and northern Florida. Machines were operated from about the middle of August until the end of October, at which time ginning was largely completed. All trash from the gins in these areas was inspected. Hot, dry weather caused the cotton to open rapidly, so that by the middle of August most of the bolls were open. Before very much picking was done, however, rains set in and continued for several weeks. Picking was thus delayed, and in many cases cotton was stored or remained open in the fields several weeks before being ginned. In many cases the trash at the gins was rained on before

it could be inspected and the amount of trash per bale was, of course, increased. All of these factors naturally tended to lower the efficiency of inspection. In the western extension of Texas inspections were intensified. Conditions there were more favorable and a large volume of trash was inspected without any specimens being found. In Pima County, Ariz., trash was inspected throughout the ginning season with negative results as far as the pink bollworm was concerned. In the Safford area of Arizona only 7 specimens were found this season as compared with 20 last season. In the Pecos Valley of Texas and the Mesilla Valley of New Mexico bolls inspected from the 1934 crop did not show any infestation; therefore gin-trash machines were run for short periods in these areas merely to obtain evidence of infestation.

Table 18 gives a summary of the various methods of inspection together with the number of specimens found.

TABLE 18.—*Summary of inspections for the pink bollworm in regulated areas, crop season of 1935*

District	Gin trash		Field		Laboratory	
	Quantity	Pink bollworms	Time	Pink bollworms	Samples	Pink bollworms
	Bushels	*Number*	*Man-days*	*Number*	*Number*	*Number*
Southern Georgia [1]	3,104	0	14	0	0	0
Northern Florida	4,138	0	11	0	149	0
Western extension, Texas and New Mexico	9,643	0	0	0	202	0
Pecos Valley, N. Mex.	0	0	0	0	120	0
Pecos Valley, Tex.	78	20	0	0	113	0
Big Bend, Tex.	0	0	0	0	20	6,193
Hudspeth County, Tex. (southeastern part)	0	0	0	0	60	175
El Paso Valley, Tex.	0	0	0	0	254	11
Mesilla Valley, N. Mex.	117	18	0	0	255	0
Tularosa, N. Mex.	0	0	0	0	0	0
Deming, N. Mex.	0	0	0	0	0	0
Duncan Valley, Ariz. and N. Mex.	150	0	0	0	43	0
Safford Valley, Ariz.	3,241	7	0	0	53	0
Tucson, Ariz.	1,945	[2]	4	0	0	0
Total	22,416	45	29	0	1,269	6,379

[1] The Georgia area was released from regulations Dec. 5, 1935.
[2] Pink bollworm results negative, but 30 specimens of the thurberia weevil found.

INSPECTIONS OUTSIDE REGULATED AREAS

Following the discovery of the pink bollworm in Jackson County, Fla., in 1934, intensive inspections have been carried on in adjacent counties in southwestern Alabama each season. In addition, considerable work has been done in other counties a little farther removed. In the season of 1935 three machines were used from the latter part of August until the middle of October. Intensive inspections were also carried on in counties surrounding the regulated areas in Florida and Georgia. Another area in which intensive inspections were carried on was in the counties surrounding the western extension of Texas. Inspections were made in the lower Rio Grande Valley of Texas, as usual, beginning the 1st of August. The machines moved northward and operated on through central and west-central Texas. Among the many places where inspections were carried on were the formerly infested zones at Hearne, Ennis, and Marilee. A considerable amount of inspection was performed in the Salt River Valley of Arizona, where an infestation was eradicated several years ago. In Oklahoma a crew using a small machine carried on inspections in the southwestern part of the State. A small amount of inspection was done in New Mexico; however, most of the cotton grown in this State is in regulated areas. It has been several years since gin-trash inspections were made in Louisiana and Mississippi. Green bolls collected in the southern part of each State have been inspected each season, and this season it was considered advisable to carry on some gin-trash inspections in that part of each State not covered by the boll inspections. The usual inspections were carried on in

Mexican States adjacent to the Texas border. As mentioned in the introduction, the results were all negative outside regulated areas. Infestation has existed in the Juarez Valley of Mexico, which is opposite the El Paso Valley of Texas, for a number of years. The inspections in that area were again made by hand from time to time, and specimens of the pink bollworm were found. Immediately after the ginning season was completed the inspection of green bolls and bolly samples collected in the various cotton States was begun at the laboratory. The results of this inspection were negative at the close of the fiscal year, but all of the material has not yet been inspected.

Table 19 gives a summary of the various kinds of inspection and the amount of material inspected.

TABLE 19.—*Summary of inspections for the pink bollworm outside regulated areas, crop season of 1935* [1]

State	Gin trash	Field	Laboratory	State	Gin trash	Field	Laboratory
	Bushels	*Man-days*	*Samples*	Mexico:	*Bushels*	*Man-days*	*Samples*
Alabama	10,250	1	84	Chihuahua [1]	6	0	0
Arizona	6,383	0	0	Coahuila	43	0	0
Florida	654	0	36	Nuevo Leon	309	0	0
Georgia	6,296	0	213	Tamaulipas	592	0	0
Louisiana	1,555	0	0				
Mississippi	1,251	0	0	Total	941	0	0
New Mexico	75	0	17				
Oklahoma	926	4	0	Grand total	42,512	11	3,159
Texas	14,181	6	2,809				
Total	41,571	11	3,159				

[1] All results negative, except that 17 pink bollworms were found in the Juarez Valley of Mexico.

WILD COTTON IN SOUTHERN FLORIDA

In June 1932 a rather heavy pink bollworm infestation was found in wild cotton in southern Florida. The eradication of this wild cotton was immediately begun, to remove this menace from the main Cotton Belt, and has been continued each year since. This year especially good progress was made with work carried on with emergency relief funds provided by the Works Progress Administration. Because of climatic factors it is possible to work only during the fall, winter, and spring months.

In 1935 the work was begun about the middle of November and continued until the latter part of June. As a result of using Works Progress Administration funds, a more thorough and far-reaching program was carried out than in any previous season. Larger crews were available, which made it possible to cover the territory more thoroughly than ever before and also to cover large areas not previously entered. These areas were in the general vicinity of known wild cotton, but as a rule were not ideal for its growth; however, it was important that they be investigated. The largest continuous wild cotton area is on Cape Sable on a strip about 35 miles long, fronting on Florida Bay and the Gulf of Mexico and ranging in width from a few yards to 3½ miles. Some of this area had never before been cleaned, but by the end of the season the entire known cotton area in southern Florida had been cleaned at least once and many of the locations several times. Many of the more accessible locations have been kept free of mature plants for the last two or three seasons, and at each recleaning it is very noticeable that there is a considerable decrease in the number of seedling and sprout plants. During the year a first clean-up was made covering 5,051 acres, from which 101,781 mature and 86,158 seedling plants were removed. In addition, a recleaning was made of the areas previously cleaned, and 11,350 mature, 2,734,676 seedling, and 56,746 sprout plants were removed. This might seem to be a large number of mature plants to remove from areas previously cleaned, but it is due to the fact that the area was covered more thoroughly than ever before. The records show that 97 percent of the mature plants were removed during the first cleaning; and, considering the area in which the plants occurred, this is a very good record. Since the clean-up was first begun, a little over 8½ million plants have been destroyed. Of this number 17 percent were mature plants, 80 percent seedlings, and 3 percent sprout plants.

In addition to the actual clean-up, nearly 164,000 acres were thoroughly scouted without any wild cotton being found. A result of all this scouting is a more thorough knowledge of the exact location of all wild cotton in southern Florida.

In order to obtain information regarding infestation in the wild cotton, bolls were inspected as the plants were being destroyed. In the summer of 1932 infestation could readily be found in the vicinity of Bradenton, in Manatee County, and a rather heavy infestation occurred on several keys just off the coast in this county. Infestation could also be readily found, but to a lesser extent, in Sarasota and Charlotte Counties. Bolls from these counties have been inspected each season since 1932 without any infestation being found, and this year some 1,500 were examined, also with negative results. The progress made in these counties is particularly encouraging because they are closest to domestic cotton. Infestation was also found in 1932 in Lee and Collier Counties, the Cape Sable district of Monroe and Dade Counties, and on the mainland keys. The heaviest infestation was on Cape Sable and was at least 50 percent in places. There has been a reduction in the infestation each year and this year no specimens were found. A total of 20,250 bolls, representing the wild-cotton area, were inspected and the results were negative for the mainland of Florida. However, 215 specimens of the pink bollworm were found in bolls from several small keys off the coast of Monroe and Dade Counties. These are the two southernmost counties of Florida, thus making the infestation as far removed from domestic cotton as is possible.

CONTROL PROGRAM IN THE BIG BEND AREA OF TEXAS

The pink bollworm infestation in the Big Bend area of Texas was heavier during the 1931 crop season than ever before, and early investigations indicated that the infestation would be still heavier during the 1932 season. Therefore, in the fall of 1932 a special program was begun to reduce this heavy infestation and thus lessen the danger of spread of the insect to the main Cotton Belt. These measures have been continued each year since and consist of a thorough clean-up of cotton fields and premises after picking is completed, delayed planting of cotton the following spring so that the peak of moth emergence will be over before the cotton begins fruiting, and the use of trap plots of cotton to trap the late-emerging moths.

The cleaning of cotton fields of the 1935 crop was begun on November 1. In a few fields the infestation was heavy, and there were heavily infested spots in other fields. An effort was made to clean such places early in the season before many larvae might go into the ground for hibernation. This effort was only partially successful, as a good top crop was made, and farmers naturally wanted to pick all of the cotton they possibly could. The stalks were cut with machetes, as usual, but this year specially constructed hand rakes were used for getting up the debris to replace the previous custom of picking such material by hand. The rakes proved much more economical and efficient, in that many fallen squares, blooms, and immature bolls, which oftentimes contained pink bollworm larvae, were collected, whereas laborers would gather only the bolls and locks in which they could see open cotton. After the stalks were cut and the material raked it was all burned. Approximately 90 percent of the cotton in the Big Bend is produced in Presidio County from the mouth of the Conchos River southward some 20 miles to the mouth of Alamito Creek. All of the fields in this section were cleaned. Above the mouth of the Conchos very little cotton was produced, because of a water shortage; however, all fields in this section were cleaned if the worm population justified it. The small acreage at Castolon, in Brewster County, was also cleaned. The clean-up was completed on January 23, 1936, a total of 2,262 acres having been cleaned at an average cost per acre of $3.56. Part of the labor expense this year was borne by the State of Texas, insofar as funds would permit, the remainder being furnished by the Bureau. The labor cost was divided as follows: Federal, $5,561.10; State, $2,490.91; a total cost of $8,052.01. Following the field clean-up, a house-to-house canvass was made, and several lots of seed cotton which might have harbored infestation were disposed of.

It has been determined that cotton planted after April 15 does not begin fruiting before the majority of pink bollworm moths have emerged. Therefore farmers have been requested each year not to plant before this date, so that there would be no early fruit on which the insect could propagate. This date has always been observed in the past, but this year two small fields were planted

before April 15. The third measure in the program is the planting of small plots of cotton to trap the later moths. The cotton is planted in the fields as early in the spring as possible, with the farmers preparing the soil, planting, and taking care of the cotton until it reaches the blooming stage. Inspectors of this project collect and destroy all blooms daily. This year cool weather during April so retarded the plot cotton that it did not get as early a start as usual. The weather, of course, affected the field cotton also; and even though the trap plots were not as far ahead of the field cotton as desired, indications were that they will serve their purpose. Much larger plots than usual are being used this year, and as a result it is impossible to inspect all of the blooms. Enough blooms are inspected, however, to give some idea of the moth emergence. The cotton began blooming about the first of June, and by the middle of the month a considerable number of worms were being found. The last week of June there was a considerable decrease in the number found. The field cotton was beginning to bloom by the close of the fiscal year, and a few specimens were being found in some of the fields, but it is still too early to obtain very accurate indications as to what the infestation will be like this coming season.

CHANGES IN REGULATIONS

The pink bollworm quarantine regulations were revised effective December 5, 1935, for the purpose of releasing from restriction all parts of the State of Georgia formerly included in the regulated areas. The regulated areas under this revision now include 3 counties in southern Arizona, 14 in north-central Florida, 9 in southern New Mexico, and 17 entire counties and parts of 4 additional ones in western Texas. Of this area five counties and part of another in Texas are designated as heavily infested and the other areas as lightly infested.

On March 1, 1936, administrative instructions were issued approving alternate treatments for baled lint cotton from heavily infested areas. These treatments are (1) steam sterilization when followed by standard or high-density compression and (2) roller treatment of lint, with proper safeguards against contamination.

On April 13, 1936, administrative instructions were issued allowing the movement of baled cotton lint and linters produced from sterilized cottonseed from the regulated areas of Florida without restriction other than a permit. This action was taken because no pink bollworm infestation was found in the regulated area of Florida during the 1935 season.

CONTROL AND ERADICATION MEASURES

The present measures enforced to control and prevent the spread of the pink bollworm from infested areas are (1) disposal of gin trash; (2) sterilization of seed; (3) supervision of oil mills; (4) fumigation, compression, steaming, and roller treating of lint; and (5) road stations.

DISPOSAL OF GIN TRASH

Practically all gins are equipped with cleaning machinery which removes a considerable amount of trash from seed cotton before it enters the gin stands. Pink bollworm larvae, the number depending upon the degree of infestation, are discharged with the gin trash. The trash is therefore disposed of by burning, sterilization, or grinding up until the first killing frost in the fall.

SEED STERILIZATION

Gins within the regulated areas are equipped with machines whereby seed is heated to a temperature of 145° F. as a continuous process of ginning. Inasmuch as the principal means whereby pink bollworm infestation is spread is infested seed, sterilization is the most important single measure enforced against the insect. These sterilizers are all equipped with a thermograph which records the temperature of the seed at all times. During the season 105 sterilizers were operated and slightly over 123,000 tons of seed were treated. The regulations permit seed heated to 145° for 30 minutes, and handled thereafter so as to prevent contamination, to move to any designation. This treatment is to take care of planting seed, and during the season several tons were so treated.

SUPERVISION OF OIL MILLS

In two of the regulated areas there are no oil mills and another area has only one mill. This makes it necessary each year to designate outside mills to handle regulated seed. A sufficient number of mills are designated to furnish ample crushing facilities for the seed involved and at the same time allow ginners and farmers competition so that they may obtain a fair price for their seed. These designated mills are equipped with machinery to give the seed preheating immediately upon arrival. During the season approximately 105,500 tons of seed were crushed at the 29 oil mills operated. Several mills have roller equipment, and 10,310 bales of linters were so treated.

FUMIGATION, COMPRESSION, STEAMING, AND ROLLER TREATMENT OF LINT

Only one fumigation plant was operated, at which 3 bales of lint and 2,355 bales of linters were treated. Of the linters 1,906 bales were domestic and 449 had been imported from the Juarez Valley of Mexico. There was also a lack of compresses in some of the areas, so that it was necessary to designate outside ones. At the 19 compresses operated, approximately 237,000 bales of lint and 2,200 of linters were compressed. A steam pressure machine was again operated by the State of Texas at Presidio, and 1,186 bales of lint were treated. A number of gins have installed roller equipment, and approximately 24,500 bales were so treated.

ROAD STATIONS

A road inspection station was again operated at the junction of the Presidio and Ruidosa roads, 1½ miles south of Marfa, Tex., to prevent movement of infested material from the Big Bend section. It was operated from September 1 to December 31, 1935, at which time field clean-up had reached the stage where there was practically no infested material which might be moved from the section. A total of 4,280 cars were inspected and 42 confiscations made. The confiscated material consisted of 9 pillows and 5 mattresses made of seed cotton, 218 sacks, 27 lots of seed cotton, and 1 lot of cotton bolls. Ten of the confiscations were found to be infested with the pink bollworm, and 357 specimens were taken, 336 of which were alive and 21 dead.

COOPERATION WITH MEXICO

A considerable amount of cotton is produced in Mexico immediately adjacent to the Big Bend section and El Paso Valley of Texas. This cotton, also, is infested with the pink bollworm, and Mexican officials are making an effort to control the insect with measures similar to those enforced by this Bureau, such as seed sterilization and field clean-up. Frequent contacts are made by inspectors of this project and Mexican officials in the fight against the pink bollworm, and a very fine spirit of cooperation has existed between the two organizations.

THURBERIA WEEVIL CONTROL

The majority of the cotton acreage in the Thurberia weevil area of Arizona is in what is known as the Rillito-Marana section, which begins about 18 miles above Tucson and extends northward for another 12 miles. Small acreages are also grown from 20 to 30 miles south of Tucson. This season about 5,000 acres were planted to cotton, of which about 1,000 acres were in Pima, or the long-staple variety, and the remainder short staple. A gin for long-staple and a gin for short-staple cotton were operated, and all of the trash produced was inspected with a gin-trash machine. A light weevil infestation was found throughout the section, a total of 30 specimens being taken. The same measures used in controlling and preventing the spread of the pink bollworm are used against the Thurberia weevil. These consist of disposal of gin trash, sterilization of seed, treatment of lint, and clean-up of gins, oil mills, etc., at the end of the season. The results of these activities are included in the figures given for the pink bollworm.

The presence of the Thurberia weevil in the United States was first discovered in the latter part of 1912, on the southern slopes of the Santa Catalina Mountains near Tucson. The native host of the insect is *Thurberia thespesioides*

Gray, a malvaceous plant closely related to cotton. The commercial planting of cotton began in the Santa Cruz Valley about 1918, and in September 1920 the first infestation of the weevil was found in cultivated cotton. Almost every year since then light infestations have been found. The infested *Thurberia* plants in certain nearby mountain ranges furnish a constant source of reinfestation, and to remove this menace it was decided to attempt the eradication of these plants. Emergency relief funds were provided by the Works Progress Administration.

Active work was begun on August 20, 1935. A few men were first trained as labor supervisors, and after the necessary equipment was secured the labor force was increased to over 200. Work was begun in the Tortillita Mountains northwest of Tucson, which is the range nearest to cultivated cotton. Work on this range was completed on February 14, 1936, 64,680 acres having been gone over and 59,283 *Thurberia* plants destroyed. These plants ranged in size from seedlings just a few inches high to plants as high as 12 feet. They usually occur in small colonies. The next nearest range is the Santa Catalina Mountains, and work was immediately begun in this range, which is much rougher than the Tortillitas. At times it was necessary to lower men with ropes from 600 to 800 feet from the top of a cliff to ledges where plants occurred. Plants were much more numerous in this range, and most of them were infested with the weevil. At the close of the fiscal year 38,560 acres had been covered in the Santa Catalinas and 554,607 plants destroyed. The above acreage consists of a strip about 2 miles wide extending from the southwest corner of the range about 9 miles northward along the westward slope and about 17 miles eastward along the southern slope.

Laborers are transported from Tucson each morning to the mountains and returned to Tucson at the end of the day. To do this highways are used as far as possible, but in order to get through the foothills and onto the ranges it has been necessary to do considerable work on the trails before they were safe for the trucks to pass over. It was necessary to construct new trails in some places so that the men could be transported as near the place they were to work as possible.

BEE CULTURE

Headquarters for the Division of Bee Culture were moved from Somerset, Md., to the National Agricultural Research Center, Beltsville, Md., where, in addition to the administrative work, research is in progress.

Colonies of Caucasian, Carniolan, common black, and Italian bees inoculated with European foulbrood all became infected. Pure Caucasian bees, however, cleaned out the disease more quickly than did the other races. Common black bees were the least active in doing so.

Bacillus larvae, a bacterium that causes American foulbrood, was found to possess a remarkable resistance to heat. Spores of this organism were viable in culture after having been boiled in water for 4 hours at Beltsville. This is contrary to the belief that boiling in water for a few minutes kills the spores. They were also viable after having been subjected to dry heat at 100° C. for 5 days.

During the year 838 samples of comb, brood, and adult bees were received for diagnosis. Very few samples of treated combs were received for sterility tests, indicating that beekeepers are not attempting to save infected combs to the extent they were a few years ago.

Ten samples of honey taken from supers of colonies infected with American foulbrood and three samples of commercial honey from slightly infected apiaries were fed to healthy colonies. The number of spores in the samples ranged from 28,000 to 93,000 per cubic centimeter, all being close to the border line of the minimum infectious dose of 1 liter of sugar sirup containing 50,000 spores per cubic centimeter. Two colonies developed disease and two others showed a slight infection, which later disappeared.

In cooperation with the University of California, an analysis of 60 western crude beeswaxes showed a great variation in physical and chemical constants as compared with slight variations in the constants of virgin beeswaxes. The cause of these variations appears to be the content of impurities. The wax constants give little indication as to the suitability of crude waxes for bleaching by sunlight, absorption, or chemical reagents. The most common soluble impurities in beeswax are apparently pollen components, iron stains, and propolis. Waxes having appreciable quantities of propolis can be bleached only with

difficulty. Crude waxes could well be graded according to the class of impurities present rather than according to their chemical and physical constants. The treatment of crude waxes with dilute oxalic or sulphuric acid appears to have little effect on acid number, an important factor in the cosmetic industry. "Bloom" on beeswax has been found to be due to a wax component that is soluble in wax solvents but not in dilute acids or bases. Its melting point is about 24° C. below that of wax.

Studies dealing with pollen supplies, brood rearing, and adult population reveal that deficiency in pollen is a major cause of weak colonies. In the orange-growing territory in California bees rapidly depleted their artificially supplied reserves. In some localities, however, as in the deciduous-fruit areas, there is apparently a sufficient field surplus for short periods to permit pollen-reserve storage. Laboratory and field tests strongly emphasize that surviving populations of overwintered colonies are directly proportional to the quantity of pollen stored in the fall, provided all other colony requirements are adequate. Preliminary studies indicate that package bees may be established at such a time prior to the active season as honey and pollen reserves can be provided in sufficient quantities to sustain a colony until a field supply is available.

Studies in cooperation with the Oregon Agricultural Experiment Station reveal a deficiency in bee population in numerous Oregon fruit-growing districts. The list of known honey plants includes 128 species. The concentration of nectar in certain of these plants ranges in sugar content from 5 to 77 percent. Bees were found to be so sensitive to the sugar variation that certain fruit blooms were ignored in preference for those yielding richer nectars. Oregon maple and mustard in particular are formidable competitors. A similar variation has been found between varieties of a species of honey plant—an important factor hitherto ignored in pollination studies.

The bee-breeding work during the year shows definitely the need of finding easily recognizable characters that can be used in pursuing studies on inheritance, and a search is being made for such characters. Work under way includes a study of the inheritance of the yellow scutellum, characteristic of Cyprian bees. A distinct yellow coloration of mouth parts, apparently a mutation, has been discovered, and an effort is being made to obtain a homozygous strain. Apparently this character is recessive.

Samples of Tahitian, Cyprian, Carniolan, and selected crosses obtained by the Watson method are on hand and await analysis. Material improvements have been made in the microsyringe used for making inseminations, and a glossometer has been devised which enables a quick reading to be made of the usable tongue length of colonies.

Studies are being made in commercial queen yards to determine the reasons for losses of queens during rearing and mating. Such factors as the effect of size of nucleus, physiological aspects of the number and age of worker bees, kinds and quantities of food available, and the final development of queens are being investigated.

Over 880 packages of bees have been under observation this spring in apiaries of commercial cooperators in a study of the supersedure of queens shipped in packages. Over 200 queens shipped separately and introduced into colonies in the fall for requeening are also under observation. A considerable variation has been found between the stocks of different shippers, indicating that an important part of the problem may rest with the conditions affecting the production of queens.

INVESTIGATIONS OF INSECTS AFFECTING MAN AND ANIMALS

SCREWWORMS AND OTHER BLOWFLIES

Research on the biology and habits of screwworms and other blowflies and on the development of more economical and effective control methods against these pests has been continued. Data obtained as to the effect of climatological factors on the development of screwworm flies have made it possible to define hibernation areas more accurately than heretofore and to determine factors which contribute toward bringing about outbreaks. With this information as a guide, it will be easier to recommend where control work should be concentrated to give maximum results and retard dissemination of the flies. Studies have shown that the flies can travel a distance of at least 9 miles. Natural migration of the flies in 1936 from areas in Texas, where they overwintered, north-

ward into Oklahoma was found to be 50 to 75 miles during March and April, 125 to 150 miles in May, and 150 to 200 miles in June.

It was found that approximately 4 percent of the cottontail rabbits in certain localities in Texas were infested with screwworms. Numerous infestations also occur in deer, coyotes, opossums, and other wild animals. Wildlife not only suffers but it also serves as a reservoir for the reinfestation of domestic animals by this fly.

Investigation of the relative economic importance, in the Southeastern States, of the various species of wound-invading blowflies other than the primary screwworm fly (*Cochliomyia americana* C. and P.) show that species of *Phormia*, *Lucilia*, and *Calliphora* and *Cochliomyia macellaria* F. are involved in about 13 percent of the cases in domestic livestock. Heavy infestation by these species, which often follows from 6 to 10 days after the attacks of the primary screwworm fly, may kill the infested animal quickly. Studies on the lethal effect on animals of larvae of *C. americana* and *C. macellaria* indicate that the effect of the former is approximately four or five times as great as that of the latter.

Work on the biology, habits, and control of the primary screwworm fly has been greatly accelerated by the development of a method of rearing stocks of larvae on an artificial medium. Heretofore the rearing of these flies has required the use of large numbers of live laboratory animals.

In the work of developing more effective screwworm larvicides and repellents, over 200 different chemicals and mixtures have been tested. Some of the many materials tried as larvicides which gave promising results are a mixture of benzol and carbon tetrachloride containing 10 percent of ground derris root, soluble pine oil and 5 percent of nicotine, wormseed oil, and phenothiazine as a dust. In small-scale tests ground derris root, rotenone, or derris resinate added to pine-tar oil appears to be more effective as a fly repellent than pine-tar oil alone.

Considerable attention has been given to the study of the biology and means of preventing infestation of the Gulf coast tick, one of the most important predisposing causes of screwworm attack. It has been found that the meadowlark is the principal host of the immature stages of this tick. Mixtures of pine-tar oil with rosin residue and sulphur applied to the ears of animals have a more lasting repellent action against the tick than other materials tested.

THE SCREWWORM IN PUERTO RICO

The true or primary screwworm (*Cochliomyia americana*) was found to be widely distributed over the entire island of Puerto Rico, from sea level to the highest mountains, and to be a serious problem. Wounds, if neglected, were sure to be infested with maggots within a few days. The high valuation of cattle per head in Puerto Rico and the fact that all animals are under daily observation, with consequent quick treatment, keep the screwworm from being more serious, particularly in the case of cattle belonging to the larger owners and sugar centrals. This fly normally oviposits only in wounds of living animals. Twelve continuous generations were reared on wounded guinea pigs during the period October 13, 1935, to September 1936, showing that 13 generations develop during an entire year. Breeding, although somewhat retarded, continued throughout the winter, during which the lowest recorded temperature was 56° F. The season of greatest activity was during May, June, and July. No evidence of parasitization was observed.

HORSE BOTS

Further investigation on methods of controlling horse bots has shown that the warm-water treatment of the parts of the animal's body infested with the eggs of *Gasterophilus intestinalis* Degeer is effective in destroying more than 80 percent of this stage of the parasite, even when the air temperature is as high as 82° F.

INSECT PARASITES OF SHEEP AND GOATS

The investigations on the biologies and methods of control of the sheep nose botfly, sheep tick, and sheep and goat lice were continued throughout the year. The use of 300-mesh wettable sulphur at the rate of 10 pounds to 100 gallons of water in round dipping vats was determined to be an effective method of controlling the two species of sucking and the three species of biting lice of goats which cause heavy losses in this country.

THE HORN FLY IN PUERTO RICO

The horn fly was found to be well distributed along the coastal sections of Puerto Rico, occurring most abundantly in the region of the south coast where the annual rainfall is 50 inches or less; here it is a serious plague of cattle during the rainy season in April, May, and June. Along the northern and eastern coasts (annual rainfall 50 to 75 inches or more) this fly is not considered an important problem except during seasons of unusual drought. At Mayaguez, where a long, very wet season occurs, the horn fly is very scarce.

Over 75 species of insects were found breeding in cattle dung. The interrelationship of these and their actual bearing on the horn fly problem was worked out as far as possible. The dung beetles *Ataenius stercorator* F., *Aphodius lividus* Oliv., and *A. granarius* L. var. *guadaloupensis* F. and S., occurred in vast numbers at certain seasons and proved to be indirect enemies of the horn fly by tunneling through and scattering the dung. Ants play a very important role in dung by preying on the maggots of the horn fly and other flies, and of scarabaeid grubs.

MOSQUITOES

In addition to giving advice to other organizations on special programs for mosquito control, investigations have been carried on to determine the flight range of the more important species in the Pacific Northwest, the duration of viability of the eggs of flood-water and salt-marsh species, and control methods for snow-water, salt-marsh, and other pestiferous forms, including such measures as the maintenance of water levels in lakes, the use of larvicides and repellents, and the clearing of brush. Surveys to determine the relative abundance of the different species in Florida were continued during the year. Manuscripts have been prepared on the biology, habits, control, and taxonomy of species of the Southeast and of the more important ones of the Northwest so that such basic information will be available to persons in charge of or interested in control work.

An intensive survey was made in Puerto Rico to determine the number of species of mosquitoes present, their distribution, relative abundance and importance, breeding places, and ecological relationships. Thirty-five species were collected, among which were 12 species of *Culex*, 4 of *Anopheles*, 8 of *Aedes*, 2 of *Psorophora*, 2 of *Mansonia*, 2 of *Wyeomyia*, 3 of *Uranotaenia*, 1 of *Megarhinus*, and 1 of *Deinocerites*. In general it was found that most of the mosquito trouble was caused by salt-marsh and irrigation-ditch breeders in the Coastal Plains and along watercourses, and by the domesticated species, *Aedes aegypti* L. and *Culex quinquefasciatus* Say, in towns and villages. *Anopheles albimanus* Wied. was the principal vector of malaria. The general principles to be followed in controlling the more important mosquitoes on the island have been outlined.

SAND FLIES

The discovery of a method for rearing *Culicoides canithorax* Hoff. has enabled the breeding places of this species to be located. It has been found that it breeds principally in open salt marshes, hence it will be more difficult to control than the tree-line breeders. A method has been devised for inducing oviposition of sand flies under laboratory conditions and this will facilitate studies on the biologies of the various species and expedite the development of control methods.

Experimental diking and drying of marshes has shown this to be an effective method in preventing sand fly breeding in certain types of mangrove and pickleweed marshes subject to "trickle tides."

EYE GNATS

The studies on eye gnats have consisted principally of plot and field-cage recoveries to determine the history and species of *Hippelates* present in the vicinity of Winter Haven, Tex. While there has been a seasonal incidence of *H. pusio* Loew, corresponding somewhat to that in the Coachella Valley of California, it has been indicated that this species breeds more continuously during the year at Winter Haven. Four species not encountered in the Coachella Valley were collected.

A check of the results obtained in the Coachella Valley by following the methods of eye gnat control advocated by the Bureau shows that trouble from this pest has been largely eliminated.

TICKS AFFECTING MAN

The American dog tick, the vector of Rocky Mountain spotted fever in the East, has been given the most attention during the year. Biological studies have shown that unfed, immature stages of this tick are able to survive for a period of over 3 years and point to the necessity for continuing any control measures against this species over a considerable period.

A restricted survey of the heavily infested areas on Cape Cod, Martha's Vineyard, and adjacent islands in Massachusetts failed to demonstrate the presence of the tick parasite *Hunterellus hookeri* Howard which was introduced several years ago. Control of the tick appears to be practicable on islands where there are relatively few favorable wild hosts of adult ticks.

SURGICAL MAGGOTS

Further investigation on the excretions of blowfly maggots has shown that urea is another excretion which contributes healing effects in chronic, discharging wounds. Through cooperation with a number of physicians and surgeons throughout the country the synthetically prepared material has been tested under a wide variety of conditions, such as those obtaining in osteomyelitis, extensive infected heat and X-ray burns, diabetic and varicose ulcers, infections of the mouth, athlete's foot, carbuncles, gangrene, and certain skin infections. It has contributed to the healing of these conditions and in some cases wounds that remained unhealed for months under other treatments have yielded promptly when urea was applied. In these respects urea appears to be as effective as allantoin, the first constituent found to have healing properties, and is more readily available. It is reported as soothing in its action, reducing pain and promoting growth of healthy tissue.

HOUSEHOLD AND STORED-PRODUCT INSECTS

Fumigation with hydrocyanic acid gas of warehouses where sacked and bulk cottonseed meal are kept in storage gave good control of heavy infestations of the cigarette beetle. On account of the great damage these insects do to fabric bags used in sacking cottonseed meal, experiments were undertaken to determine the value of heavy paper bags for this purpose. While many eggs are deposited in the thread holes and along the thread used to stitch the bags and the larvae enter the meal, no characteristic exit holes so destructive to fabric bags have been found.

On account of the rapid spread of the furniture carpet beetle (*Anthrenus vorax* Csy.) since it first appeared in this country 20 years ago, and its voracious habits, it appears highly probable that this species will ultimately be classed as the most destructive carpet beetle in the United States. The beetles feed upon anything containing such animal substances as wool, hair, fur, feathers, bristles, horn, tortoise shell, and silk. Normally they do not eat vegetable fabrics, paper, leather, or softwood, but when these become stained with animal excretions or when heavy infestations develop in their favorite foods which are in close proximity to them, the beetles will extend their ravages to these substances. They may be controlled by hydrocyanic acid gas fumigation.

Investigations on the effect of cold storage in preventing infestations of the webbing clothes moth and the black carpet beetle in furs and clothing indicate that infestations by these insects cannot originate when garments are kept at a temperature of 59° F. and 42 percent relative humidity. This has an important bearing on reducing the cost of keeping furs, clothing, and other materials in cold storage during the summer.

COOPERATIVE SERVICE

In addition to its investigations and its giving of advice on control to numerous inquirers, the Division of Insects Affecting Man and Animals has continued to cooperate with various Federal, State, and local agencies by making surveys, recommending methods of control, and giving technical direction and advice on control projects financed from funds available from other sources. Among the items of this nature have been the supplying of technical advice on the control of mosquitoes to those supervising projects of the Works Progress Administration in Oregon and Florida, to the Army and Navy in the San Pablo Bay district of

California, and to the Forest Service in the Pacific Northwest; supervising fumigations of buildings, furniture, food supplies, books, documents, etc., and investigating and giving advice on insect problems presented by various Federal agencies; investigating the control of household insects for the Federal Trade Commission; testing, for the Army Quartermaster, the resistance to insect damage of treated fabrics used in manufacture of army clothing; and field testing of commercial screwworm remedies for the Food and Drug Administration.

SCREWWORM CONTROL

The cooperative campaign to control the screwworm in the Southeastern States was continued on March 15, 1936. These activities were recognized as a division reporting direct to the chief of bureau with headquarters in the field. The act making appropriations for the fiscal year 1937, approved June 4, 1936, contained an immediately available appropriation of $460,000 for work on the screwworm, and the cooperative educational and demonstrational work was extended to the Southwest, including the western part of Texas and the States of Oklahoma, New Mexico, Arizona, and California.

During 1935 and the early part of 1936 general field headquarters were maintained at Atlanta, Ga., with State headquarters in each of the cooperating States—Florida, Georgia, South Carolina, Alabama, Mississippi, Louisiana, and Texas. With the extension of the program to the Southwest, the general field headquarters were moved to San Antonio, Tex., regional offices being established in Atlanta and San Antonio and State offices in all cooperating States.

During the active season of 1935 the 316 counties in the Southeastern States where work was carried on were grouped into districts, each under the direction of a district leader, and county supervisors were employed for most of the counties. These special county leaders, numbering 248, worked in close cooperation with the county agents, held meetings, conducted demonstrations, arranged for the distribution of medicines and materials used to construct treating pens and chutes, assembled records on screwworm infestation, and carried on other activities connected with the educational campaign. With cool weather and reduction in the number of screwworm cases in all sections other than the southern part of Florida the work of the county men was discontinued on December 21, 1935, in all except certain counties in Florida. At the beginning of the active season in 1936 the distribution of free medicines and materials for the construction of pens and chutes was discontinued in the Southeast as well as the employment, on Federal funds, of county leaders.

The campaign was planned to make full use of existing State and Federal agencies. To assure coordination of the interested agencies within the States, each cooperating State organized a State committee on screwworm control. Splendid cooperation was received from county agricultural agents, veterinarians, teachers of vocational agriculture, and individual stockmen and farmers. The meetings and demonstrations were well attended by farmers and stockmen. At the 11,128 meetings and demonstrations held in the Southeast there was a total attendance of 252,182 persons. Other educational activities are summarized in table 20.

TABLE 20.—*Summary of educational work on screwworm control, fiscal year 1936*

State	Meetings and demonstrations held	Attendance at meetings and demonstrations	Stockmen visited on farms	Exhibits	Attendance at exhibits	Circulars and bulletins distributed	Posters and handbills distributed	Newspaper articles published	Pens and chutes made available	Radio talks given
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Alabama	497	40,116	36,767	14	34,420	27,971	396	79	0	0
Florida	1,157	14,680	67,373	83	197,555	17,315	5,796	411	184	6
Georgia	8,204	114,209	270,475	46	150,623	44,719	6,445	337	442	10
Louisiana	282	17,104	10,716	8	7,850	22,700	32,287	9	0	0
Mississippi	359	38,802	37,746	9	43,150	23,947	40,175	39	20	0
South Carolina	422	13,091	1,395	42	114,840	10,045	5	29	1	0
Texas	207	14,180	8,339	20	199,215	5,405	61	139	11	1
Total	11,128	252,182	432,811	222	747,653	152,102	85,165	1,043	658	17

During the summer and fall work in the Southeast, 42,143 gallons of benzol and 40,860 of pine-tar oil were distributed without charge to insure the use of proper materials in treating infested wounds. In some of the unfenced areas where chutes and pens were not available to aid in handling animals, materials were furnished free for the construction of corrals for community uses. A total of 658 pens and chutes were made available on unfenced ranges for owners of small numbers of livestock so that they could round up their animals for examination and treatment.

In the educational work the owners of livestock were advised as to the life history of screwworms, the proper methods of treating infested animals, how to prevent cases of screwworms in injuries, and how some good common-sense practices would prevent injuries. The five principal types of wounds which made favorable places for screwworm attack were stressed. These include: (1) Tick bites; (2) surgical operations, such as marking, branding, and castrating; (3) snags and scratches, such as result from hooking and goring; (4) the navels of newborn animals; and (5) the injuries resulting from the use of dogs trained to catch and hold animals or from fighting hogs. Community action and neighborly cooperation were stressed for a high degree of screwworm control. The recommended practices included having the young born early in the spring before screwworms were active; doing surgical operations, such as marking, castrating, and branding, when screwworms are not present; the tipping of pointed horns to eliminate scratching and hooking; eliminating the use of dogs so as to prevent bites of animals; eliminating projecting timbers so that animals could not be bruised or injured; the use of pine-tar oil on the ears of animals infested with Gulf coast ticks; the use of pine-tar oil on brands, wounds, and injuries; the use of pincer-type emasculators on scrub males; and the use of better sires.

Some of the more important results of the screwworm-control program are: (1) Reduction of the number of cases from approximately 1,350,000 in 1934 to actually 266,283 in 1935, (2) reduction of death losses of infested animals from more than 12 percent in 1934 to 2.13 percent in 1935, (3) prevention of spread of screwworms to more northern localities, (4) the absence of screwworms in southern Mississippi and southeastern Louisiana, (5) several changes in methods of handling livestock, such as controlled breeding, proper methods of castrating and dehorning, and closer observation of animals, and (6) the elimination of harmful mixtures and nostrums which are injurious to wounds and which usually retail at exorbitant prices. The numbers of cases of screwworms reported by weeks for the several States are given in table 21 and show clearly the reduction in numbers through the year.

TABLE 21.—*Reported cases of screwworms in Southeastern States and eastern Texas, fiscal year 1936, by weeks*

Week ended—	Alabama	Florida	Georgia	Louisiana	Mississippi	South Carolina	Texas (east)	Total
1935	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
July 6	56	3,566	998	314	35	----------	329	5,298
July 13	67	5,316	1,321	623	31	19	557	7,934
July 20	86	5,748	1,886	596	28	28	610	8,982
July 27	148	6,548	2,332	251	26	28	592	9,925
Total July 6–27	357	21,178	6,537	1,784	120	75	2,088	32,139
Aug. 3	139	6,670	2,214	331	26	47	406	9,833
Aug. 10	116	5,898	2,424	278	18	37	455	9,226
Aug. 17	119	6,700	3,016	919	13	164	1,209	12,140
Aug. 24	130	7,937	3,333	652	9	194	978	13,233
Aug. 31	115	8,453	3,297	458	3	157	833	13,316
Total July 6 to Aug. 31	976	56,836	20,821	4,422	189	674	5,969	89,887
Sept. 7	202	4,870	3,343	372	8	171	784	9,750
Sept. 14	185	6,491	3,669	701	5	153	1,013	12,217
Sept. 21	197	5,611	3,635	450	5	152	411	10,461
Sept. 28	303	4,800	3,206	397	2	184	532	9,424
Total July 6 to Sept. 28	1,863	78,608	34,674	6,342	209	1,334	8,709	131,739
Oct. 5	260	4,660	3,400	192	4	232	529	9,277
Oct. 12	183	3,866	3,396	266	1	190	797	8,699
Oct. 19	627	4,389	4,691	538	0	409	446	11,100
Oct. 26	743	4,628	5,256	671	0	613	926	12,837
Total July 6 to Oct. 26	3,676	96,151	51,417	8,009	214	2,778	11,407	173,652

TABLE 21.—*Reported cases of screwworms in Southeastern States and eastern Texas, fiscal year 1936, by weeks*—Continued

Week ended—	Alabama	Florida	Georgia	Louisiana	Mississippi	South Carolina	Texas (east)	Total
1935	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Nov. 2	706	5,311	5,293	627	0	526	954	13,417
Nov. 9	1,167	5,935	5,076	744	0	821	873	14,616
Nov. 16	1,491	6,394	5,223	338	0	1,335	882	15,663
Nov. 23	1,366	4,746	3,914	177	0	558	272	11,033
Nov. 30	508	3,357	2,165	0	0	204	201	6,435
Total July 6 to Nov. 30	8,914	121,894	73,088	9,895	214	6,222	14,589	234,816
Dec 7	220	2,645	1,333	0	0	124	54	4,376
Dec. 14	96	2,420	539	0	0	27	62	3,144
Dec. 21	32	1,801	0	15	0	0	(1)	1,848
Dec. 28	0	518	0	1	0	0		519
Total July 6 to Dec. 28	9,262	129,278	74,960	9,911	214	6,373	14,705	244,703
1936								
Jan. 4	0	379	0	0	0	0		379
Jan. 11	0	451	0	11	0	0		462
Jan. 18	0	567	0	0	0	0		567
Jan. 25	0	564	0	0	0	5		569
Total July 6 to Jan. 25	9,262	131,239	74,960	9,922	214	6,378	14,705	246,680
Feb. 1	0	481	0	0	0	0		481
Feb. 8	3	402	0	0	0	0		405
Feb. 15	0	180	0	0	0	0		180
Feb. 22	0	160	0	2	0	0		162
Feb. 29	0	230	0	0	0	0		230
Total July 6 to Feb. 29	9,265	132,692	74,960	9,924	214	6,378	14,705	248,138
Mar. 7	2	338	0	0	0	0		340
Mar. 14	0	211	0	0	0	0		211
Mar. 21	0	326	0	0	0	0		326
Mar. 28	12	322	0	0	0	0		334
Total July 6 to Mar. 28	9,279	133,889	74,960	9,924	214	6,378	14,705	249,349
Apr. 4	19	484	0	2	0	0		505
Apr. 11	4	638	0	0	5	0		647
Apr. 18	10	1,392	0	0	5	0		1,407
Apr. 25	50	1,257	0	3	9	0		1,319
Total July 6 to Apr. 25	9,362	137,660	74,960	9,929	233	6,378	14,705	253,227
May 2	3	1,469	1	5	6	0		1,484
May 9	14	1,188	0	20	56	5		1,283
May 16	30	1,533	0	8	20	0		1,591
May 23	46	1,487	0	30	11	0		1,574
May 30	37	1,368	2	4	1	11		1,423
Total July 6 to May 30	9,492	144,705	74,963	9,996	327	6,394	14,705	260,582
June 5	4	1,572	43	8	13	4		1,644
June 12	23	460	37	13	109	10		652
June 19	3	972	26	7	4	7		1,019
June 26	66	1,264	21	13	16	4	802	2,186
Total July 6 to June 26	9,588	148,973	75,090	10,037	469	6,419	15,507	266,083

[1] Beginning with the week ended Dec. 21, 1935, reports for Texas do not indicate number of cases. There were scattered cases over the area worked.

The screwworm-control program also promoted among stockmen a desire to produce better breeds of animals. Throughout the area there are many trading centers where animals of good blood are sold at auction at least once or twice each week. The more improved animals now being secured to replace the scrubs are given more attention by the owners and hence are less likely to become infested with screwworms. This replacing of scrub animals which were rarely examined and served as a reservoir for screwworms contributes to screwworm control. When the screwworm first made its appearance in the Southeast in 1934, livestock owners were not aware of the proper methods of treating and preventing cases, and practically a state of hysteria existed. At that time doubt was expressed not only by stockmen but by representatives of various State agencies and by the editors of many newspapers as to the future of the livestock industry in these States. In some instances livestock owners abandoned the raising of livestock. At the close of the year this situation is reversed. Livestock owners have been advised as to the best methods of preventing and treat-

ing cases, and many have been convinced that they can control screwworms. Doubt as to the outlook for the industry from this cause has disappeared, better animals are being purchased, herds are being enlarged, and new packing plants are being opened.

INSECT IDENTIFICATION

The number of identifications, 53,293, represents an increase of 20 percent over the number reported for 1935, the increase being due to larger numbers of interceptions by the Division of Foreign Plant Quarantines referred to the Division of Insect Identification for determination. Altogether, 37,796 distinct lots of material were involved. At the end of the fiscal year work on nearly 6,000 lots remained unfinished. Owing to the volume of identification work, only a very small amount of time remained available for the numerous research problems in the classification of insects that require solution before more complete and accurate identifications will be possible in many groups. Nevertheless, various relatively minor but important research undertakings in classification have been conducted, and a number of new species have been described for which names have been urgently needed in economic or biological studies conducted by this bureau and other agencies or individuals. In addition, certain studies in morphology, which have a direct bearing on classification and identification of insects, have been completed and others undertaken. Thirty-four papers, mostly short, reporting the results of taxonomic and morphological studies, or describing new species, have been published during the year.

FOREIGN PARASITE INTRODUCTION

During the year particular attention was given to the importation of natural enemies of the oriental fruit moth, the pine shoot moth, the larch casebearer, and the alfalfa weevil. Also large-scale importations of fruitfly parasites were made into Hawaii under special funds provided for this purpose and into Puerto Rico against the sugarcane borer and other pests. With few exceptions, importations were made in the adult stage, thus eliminating any risk which might be involved in bringing living host material into the United States.

The principal hosts of the parasites imported into the continental United States and the countries in which the material was obtained are as follows:

Insect hosts of the parasites and countries in which the material was collected

Oriental fruit moth	Japan, Chosen.
Japanese and Asiatic beetles	Do.
European corn borer	France, Japan.
Alfalfa weevil	France, Italy.
Pine shoot moth	England.
Larch casebearer	Do.
Elm leaf beetle	France, Japan.

ORIENTAL FRUIT MOTH PARASITES

Shipments of parasites of the oriental fruit moth during the fall of 1935 comprised 657 adults and 549 cocoons of *Perisierola* sp., 2,651 adults of *Phaeogenes* sp., and 10,510 miscellaneous parasite cocoons. A total of 242,565 infested twigs were collected in Japan and Chosen in the spring of 1936 and from these 30,928 parasite cocoons and puparia were secured for shipment to the United States. A considerable number of species are represented in this material.

JAPANESE AND ASIATIC BEETLES

Small-scale importations of parasites of the Japanese and Asiatic beetles were continued during the year. One shipment of the Yokohama strain of *Tiphia popilliavora* Roh. comprising 253 adults was forwarded in October 1935 for colonization against the Japanese beetle. A total of 4,236 adults of *Tiphia sternata* Park. were forwarded during May for use against the Asiatic garden beetle.

EUROPEAN CORN BORER PARASITES

The collection work for parasites of the European corn borer was limited to central France, with the object of securing a sufficient supply of *Microgaster tibialis* Nees for colonization purposes. A total of 11,908 cocoons of this para-

site were collected from *Artemisia* in the Paris section during November and December 1935. In addition, the cooperative work in Japan with the Canadian Department of Agriculture, for which the costs of collection were defrayed by that department, has provided a number of colonies of several parasites for liberation in the United States.

ALFALFA WEEVIL PARASITES

A total of 5,000 adults of alfalfa weevil parasites, largely *Peridesmia phytonomi* Gahan, were reared at the laboratory in southern France and forwarded to California, where the colonization work is being handled cooperatively with the State Agricultural Experiment Station. These parasites attack the egg stage of the alfalfa weevil. A larval parasite, *Tetrastichus incertus* Ratz., was reared in the laboratory and 778 parasitized host larvae were forwarded during April and May. These are expected to produce approximately 7,000 adults for colonization in the infested sections.

EUROPEAN PINE SHOOT MOTH PARASITES

Extended collections of shoots infested by the European pine shoot moth were made in England during May and June and the material examined for parasites. A total of 6,775 parasite cocoons were isolated and forwarded. These represented five species, several of which were different from those imported from Austria in previous years.

LARCH CASEBEARER PARASITES

The collection work on the larch casebearer was done in England during May and 102,340 cases containing fully developed larvae were secured and shipped to the United States for rearing. The parasitization of this pest in England proved to be considerably lower than that in Austria in previous years. Several desirable parasites not previously secured in Austria, however, were represented in this material.

ELM LEAF BEETLE PARASITES

Fifty thousand adults of the elm leaf beetle were collected in southern France during the winter and shipped to the United States for rearing of the tachinid parasite *Anachactopsis nitidula* Rond. One shipment of field-collected eggs comprising 533 clusters was forwarded from Japan to California. These were heavily parasitized by *Tetrastichus* sp., a form different from that previously imported from Europe.

FRUITFLY PARASITES FOR HAWAII

Four expeditions into tropical countries in search of natural enemies of fruitflies were sent out in the fall of 1935, and these began their exploratory work in East Africa, West Africa, Brazil, and India, respectively. The first shipments of fruitfly parasites were made in January, and since that time three species from West Africa and three species from Brazil have been liberated in Hawaii. In addition, two species of predacious staphylinid beetles from Brazil which feed upon fruitfly larvae have been received and colonized. Numerous shipments of *Opius crawfordi* K. and P. have been received from the Bureau laboratory in Mexico and of *Opius anastrephae* Vier. from Puerto Rico. Incidental to the fruitfly work, two parasites and several scale insect predators of the pineapple mealybug were received from Brazil.

INTRODUCTION OF NATURAL ENEMIES OF INSECTS INTO PUERTO RICO

A special activity provided for importing into the island of Puerto Rico natural enemies of insect pests. In the exploratory work special attention was directed to the parasites of the sugarcane borer. The one expedition to the British West Indies and South America was in the field from October 1935 to May 1936. The first shipment of parasites was received from Hawaii in September 1935 and during the remaining portion of the year 37 species of parasites and predators were received and colonized. These represent a total of 115,354 parasites imported during that period. Eight of the introduced species have been recovered and three of them have been sufficiently well established to permit recolonization from the established colonies. The hosts of these natural enemies and the countries of origin are given in table 22.

TABLE 22.—*Importation of parasites and predators into Puerto Rico during the fiscal year 1936*[1]

Host	Species of parasites	Species of predators	Country of origin
	Number	*Number*	
Sugarcane borer	3	0	British Guiana.
Do	2	0	Peru.
West Indian fruitfly	5	0	Hawaii.
Do	1	0	Mexico.
Do	6	0	Brazil.
Do	2	0	Canal Zone.
Do	1	0	Sierra Leone.
Coconut scale	0	5	Trinidad.
Pineapple mealybug	2	0	Brazil.
Do	0	1	Do.
Pink bollworm	3	0	United States.
White peach scale	1	0	Do.
Cacao thrips	1	0	Trinidad.
Banana root weevil	0	1	Fiji.
Bean pod borer	1	0	United States.
Do	1	0	Japan.

[1] In addition, 1 species of dung beetle was imported from Hawaii into Puerto Rico to aid in horn fly control.

COOPERATION WITH FOREIGN ORGANIZATIONS

The cooperative work with the entomological branch of the Canadian Department of Agriculture was continued during the year. A total of 250,000 European corn borer larvae were collected in Japan through funds provided by that department, and a portion of the parasites reared out from this material was made available for colonization in the United States. Sawfly cocoons to the number of 22,689 were also collected and forwarded to the Canadian Parasite Laboratory The parasites reared from this material are to be colonized on the spruce sawfly.

The Canadian Department of Agriculture again provided a number of colonies, comprising 11,600 adults, of *Collyria calcitrator* Grav. for liberation in the sections of Pennsylvania and Ohio infested with the black wheat-stem sawfly. In addition a number of colonies of several species of parasites of the spruce sawfly were provided for colonization in New England.

Through the courtesy of the Department of Agriculture of Fiji a consignment of 575 adult beetles of *Placsius javanus* Frogg., which is predacious on the banana root weevil, were secured for colonization in Puerto Rico. The Imperial College of Tropical Agriculture of Trinidad very kindly provided breeding stock of *Dasyscapus parvipennis* Gal., a parasite of the cacao thrips which had been imported into Trinidad from the Gold Coast in 1935. Also, the cooperation of the Department of Agriculture of British Guiana made it possible to secure a stock of the Amazon fly (*Metagonistylum minense* Townsend) for use against the sugarcane borer. Both of these parasites were for colonization in Puerto Rico.

Shipments of parasites and predators have been forwarded during the year to the countries listed in table 23.

TABLE 23.—*Shipments of parasites and predators to foreign countries during the fiscal year 1936*

Country	Host	Species
Australia	Oriental fruit moth	*Macrocentrus ancylivorus* Roh.
Do	do	*Glypta rufiscutellaris* Cress.
Egypt	Mediterranean fruit fly	*Opius tryoni* Cam.
Do	do	*Opius humilis* Silv.
Do	do	*Tetrastichus giffardianus* Silv.
Do	Cotton worm	*Bufo marinus* L.
Mexico	Pink bollworm	*Exeristes roborator* F.
Do	do	*Microbracon kirkpatricki* Wilkn.
South Africa	Codling moth	*Ascogaster quadridentata* Wesm.

CONTROL INVESTIGATIONS

CONTROL OF INSECTS BY FUMIGATION

In cooperation with certain shippers tests were made on the possibility of fumigating beans in box cars for the bean weevil (*Acanthoscelides obtectus* Say) and the southern cowpea weevil (*Callosobruchus maculatus* F.). In this work infested beans were placed in sacks of beans in cars and fumigated with hydrocyanic acid for a period of 24 hours with dosages ranging from 4 to 14 pounds per car. Each carload consisted of approximately 60,000 pounds of beans. From the results of this work, which was done at North Kansas City, Mo., and in which eight carloads of beans were fumigated, it seems probable that, at temperatures above 60° F. and with a dosage of approximately 14 pounds of hydrocyanic acid per carload, and with proper spacing of the sacks so that the fumigant can penetrate to all parts of the car, satisfactory kills of the two bean weevils could be obtained. The suggestion is made that loaded cars be fumigated in chambers for the purpose of eliminating wind currents, etc.

Work was continued on atmospheric and vacuum fumigation of vetch seed with liquid hydrocyanic acid and carbon disulphide for the vetch weevil (*Bruchus brachialis* Fahr.). At present both fumigants appear promising.

STERILIZATION OF PLANT PRODUCTS BY HIGH AND LOW TEMPERATURES

The length of exposure necessary to kill eggs, larvae, pupae, and adults of the cigarette beetle at temperatures of 10°, 15°, 20°, 30°, 32°, 36°, and 40° F. and the time necessary to cool several different types of commercial packs of leaf tobacco to low temperatures were determined. The time of exposure to produce complete mortality varies with the temperature from a minimum of 0.04 day at 10° for the eggs to 40 days at 40° for the adults. This method is adapted to the commercial treatment of tobacco for this insect.

METHOD OF APPLYING INSECTICIDES

Tests were made of high-pressure sprayers for woodland spraying for the gypsy moth. Specifications were written and sprayers purchased which were highly efficient and economical in price and upkeep.

PHYSIOLOGY OF INSECTS

In the studies of digestion in a leaf-eating insect, the southern armyworm (*Prodenia eridania* Cram.) was used and the presence of nine enzymes was shown in the digestive tract of the larvae. These were found in the tissues of the midgut. It is of interest to note that only two enzymes were found in the tissues of the foregut and only two in the tissues of the reargut. The midgut is apparently the portion of the alimentary tract in which most of the digestion takes place, or at least in which most of the digestive enzymes are secreted.

TOXIC EFFECT OF INSECTICIDES ON INSECTS

In investigations carried on during the last 2 years, a wide variation in the toxicity of various calcium arsenates to silkworms and to bean plants has been shown to exist. It has been shown also that this variation is apparently related to the amount of water of crystallization in the compound; that is, calcium arsenates from which the water of crystallization has been driven off are apparently nontoxic to both silkworms and bean plants, but where the water of crystallization is present the toxicity is decidedly higher. The extent of loss of toxicity of tricalcium and tetracalcium arsenate resulting from the application of heat depends on the duration and temperatures of heating and on moisture conditions during heating.

Insecticidal tests of 300 alcoholic extracts of flower heads of selected pyrethrum plants were made in cooperation with the Bureau of Plant Industry to correlate insecticidal activity of the toxic constituents with morphological characteristics of the plant. It was expected that this work would provide a means for selecting the most toxic plants for propagation. A method of employing mosquito larvae as test insects was developed and used for this work.

As it has not been proved that pyrethrins are the only toxic constituents of pyrethrum, tests were made of various purified fractions of a pyrethrum concentrate to find out whether any of them were more toxic than their pyrethrin content would indicate. Certain fractions were so highly toxic that further investigation of them is warranted.

A new metal insecticide-testing turntable of improved design was installed and used for testing liquid household insecticides against houseflies. Certain samples provided by the National Association of Insecticide and Disinfectant Manufacturers, who cooperated in these investigations, were tested on the turntable and these same samples were also tested by the Peet-Grady method in 10 laboratories of the association. These results were assembled and analyzed. As a result of this work the association decided for the first time to adopt a standard or control insecticide for comparative tests. The use of this standard will facilitate the detection of low-quality insecticides and will tend to raise the general level of quality. A standard specification based on insecticidal efficiency can now be formulated.

TOXICITY OF INSECTICIDAL COMBINATIONS OF TOBACCO AND TOBACCO PRODUCTS ON INSECTS

A physiological study of the effect of nicotine in solution on the heart action in the adult stages of the American cockroach and the larval stages of the southern armyworm was carried out during the year. The investigations showed that 0.4 percent of nicotine in a saline solution, when applied to the isolated heart of a cockroach, produces a temporary stimulation of the rate of contraction, followed by little or no depression. When the heart, after being held in the nicotine-saline solution for 30 to 60 minutes, was transferred to the saline solution there was a temporary depression followed by an increase which raised the rate of action to a new level. With the heart of the southern armyworm, however, the effect of 0.4 percent of nicotine was relatively slight in most cases. It seems possible that this difference in the effect of nicotine on the heart action in the two different species of insects may be due to the fact that there are ganglionic cells within the heart tissue of the cockroach while the heart of the larva of the southern armyworm apparently contains none.

In tests on the fumigation of weevil-infested dried peas and beans under reduced pressure, using volatilized nicotine, it was found possible to kill these insects within the seed with an exposure of 6 hours. Volatilized nicotine, however, does not penetrate very well into a mass of seed, and the results of this investigation indicate that it is neither so effective nor so cheap for this purpose as are some other fumigants.

Quantitative injection of nicotine and nicotine sulphate into blowflies and certain lepidopterous larvae showed that all species tested are inherently susceptible to this poison. The ineffectiveness of nicotine as ordinarily applied probably indicates its failure to reach the vital parts of the insects.

A new, soluble, crystalline, nicotine compound called nicotine humate was as effective as nicotine sulphate against aphids. The acid-alkali ratio of sodium oleate solutions, used as a spreader with nicotine, had no marked influence on the toxicity of the mixture.

A laboratory method has been developed for determining under controlled conditions the concentration of nicotine vapor and the time required to kill pea aphids and other insects. The effective concentration for the pea aphid was much lower than expected. Adsorption of nicotine on leaves was detected.

Preliminary experiments have been made on the effect of various salts on the toxicity of nicotine to mosquito larvae.

A precise laboratory method was developed for determining the relative effectiveness of various substances against the eggs of the housefly. Nicotine compounds were not effective against the eggs of this species, but oils from the dry distillation of tobacco stems and other waste plant material were promising. Suspensions of the powdered roots of certain rotenone-bearing plants and extracts of these plants were outstanding in their effectiveness against these eggs. Similar tests were also made against the eggs of the Angoumois grain moth, with better results from nicotine compounds.

TESTS TO DETERMINE EFFECT OF NEW INSECTICIDAL MATERIALS ON INSECTS

Tests were made during the year for the Division of Insecticide Investigations and for the Bureau of Plant Industry to determine the insecticidal value of various plants that are new or that are not generally employed in this

country for insecticidal purposes. Several plant products were shown to be highly toxic to insects and indicate that some of these plants may have value for the commercial production of insecticides.

In a search for insecticides that will be effective against insects but will not be harmful to the plants or render them dangerous for human consumption, a large number of organic compounds have been tested. In these tests mosquito larvae are used as test insects and those compounds that do not show toxicity to this insect are eliminated. The compounds that are toxic to mosquito larvae in concentrations of 20 parts or less per million will be tested further on other insects. During the year some 250 compounds have been tested in this way, about 50 of which have proved to be toxic at concentrations of 20 parts or less per million. About 20 of these compounds were azo compounds, and this group apparently contains a number of compounds promising as insecticides.

INSECTICIDE INVESTIGATIONS

The chemical investigations on insecticides for the year followed closely the lines pursued for several years past. The only essential change in the organization was the reopening of the field laboratory at Whittier, Calif., to resume the study of fumigation of the California red scale.

Forty-three publications dealing with the many studies of the Division of Insecticide Investigations were issued, mostly in journals outside the Department. Numerous other articles were prepared and are awaiting review or printing. Three public-service patents were issued to members of the Division.

CHEMICAL INVESTIGATIONS ON INSECTICIDAL PLANTS (TOBACCO, DERRIS, PYRETHRUM, ETC.) AND THEIR CONSTITUENTS

The study of pyrethrum powder and its active constituents, the two pyrethrins, was continued, but no satisfactory method was found for the isolation of the pure compounds in quantity sufficient to permit of a comprehensive comparison by entomologists of their relative toxicity. It was discovered, however, that the formulas heretofore accepted for these materials are incorrect, and the new formulas established by this work explain satisfactorily all of the recorded reactions of the compounds, including some that could not be reconciled with the older formulas. The new formulas identify one of the derivatives of the pyrethrins, namely, tetrahydropyrethrolone with dihydrojasmone, the odorous principle of the jasmine flower, indicating the possibility of synthesis of related compounds. It was further demonstrated for the first time that the pyrethrins are present in fresh pyrethrum flowers, and are not formed during the drying of the flowers. The flowers of the common daisy (*Chrysanthemum leucanthemum*) were examined by the new methods developed for the study of pyrethrum, and although both methoxyl-containing and acid-reacting materials were found in appreciable quantities, no pyrethrin semicarbazones could be isolated; hence the pyrethrins are absent from flowers of the daisy, and this is in agreement with the known worthlessness of daisy flowers as insecticides.

Recent reports by other investigators have indicated that nicotine occurs in the tobacco plant as a glucoside which is more poisonous to dogs and guinea pigs than is nicotine itself. Investigations by the Division show that this is not the case in the one sample of Texas Cuban tobacco examined, but that it may be partly true of Maryland tobacco, and the subject is being more fully investigated. The fixed-nicotine preparation known as nicotine peat, originally developed in the Division, was made on a semicommercial scale, and several hundred pounds were obtained for large-scale field tests. A method of making nicotine dusts from which the nicotine is given off very rapidly was developed and should prove useful in the control of pea aphids and similar insects where it appears necessary to establish a high concentration quickly. New microanalytical methods for the determination of small quantities of nicotine were developed as an aid in the study of fumigation with this compound.

Work was continued with rotenone-bearing plants, mainly derris and cube. This dealt largely with improvements in the methods of analysis and led to a much better understanding of the conditions necessary for the complete recovery of the rotenone content. A method was also proposed for the calculation of the approximate toxic value of a sample from a consideration of both the rotenone and total extractive contents, since it is recognized that it is not satisfactory to rely on the rotenone figure only. The unreliability of optical rotation as a means of estimating the rotenone content of derris or cube was demonstrated, and a study was begun of the water-soluble constituents of these plants.

A method of processing quassia for the preparation of quassin was developed, and the latter material was shown to consist of two isomers which have been separated and purified. Chemical studies on the cockroach plant (*Haplophyton cimicidum*) lead, among other things, to the isolation from it of a rare cyclic alcohol known as quebrachite.

CHEMICAL INVESTIGATIONS TO DEVELOP SYNTHETIC ORGANIC INSECTICIDES

About 100 synthetic organic compounds were made to test their possible insecticidal usefulness, such tests being made by other divisions.

Of the compounds tested against mosquito larvae, the following were most toxic, being effective at 5 parts per million or less: Phenothioxindibenzothiophene, thioxanthydrol, dibenzofuran, 2-chlorodibenzofuran, 2-aminodibenzofuran, 2-methylanthraquinone, p-chlorodiphenyl, 2, 3, 4, 6-tetrachlorophenol, n-phenyl-1-naphthylamine, phenanthrene, xanthene, p-bromonitrobenzene, and p-dinitrobenzene. In tests against the codling moth, the first three of these compounds were among the most effective, as were also 4, 6-dinitro-o-cresol methyl ether, thiocoumarin, hexachlorophenol, diphenyl disulphide, p-nitrosodimethylaniline, thioxanthone, 4, 6-dinitro-o-cresol acetate, and the three nitroiodobenzenes, of which the para compound is the best.

Following the discovery that certain azo compounds are toxic to mosquito larvae, many such preparations were made, but none of them look very promising against other insects.

Phenothiazine received considerable attention, as it is still the most promising organic substitute for lead arsenate in spraying apples. This compound is now being made by at least three companies and high-grade material is available. A tendency for it to decompose has been noted, but the action is so slight as to be unimportant. Certain derivatives of phenothiazine were also prepared, but none showed especial promise.

CHEMICAL INVESTIGATIONS ON THE REMOVAL OF SPRAY RESIDUE

The work on spray residues was active at three of the Division's laboratories, namely, those at Yakima, Wash., Vincennes, Ind., and Washington, D. C. The fruit-washing experiments conducted cooperatively with the Bureau of Plant Industry at Yakima and Washington required the making of 600 analyses for lead at the former place and over 900 at the latter. At both places it was demonstrated that 1 percent of a low-viscosity mineral oil materially aids the regular acid wash in removing lead arsenate residues.

Last year's work concerning the great variation to be found among the individual apples of a given lot were repeated this year, except that the washed and unwashed apples were taken from the same lot. One hundred unwashed fruits gave results of from 0.135 to 0.401 grain of lead per pound, with an average of 0.256 and a standard deviation of 0.056. A like number of washed fruits showed a range of from 0.014 to 0.074 grain per pound, with an average of 0.0392 and a standard deviation of 0.0143. These results indicate that if in washing experiments we wish to say with a certainty of 20 to 1 that two lots of apples really differ when our analyses give figures differing from each other by 10 percent we must obtain these figures from about 40 unwashed or 100 washed fruits. At Vincennes it was determined that a deposit of 20 micrograms of As_2O_3 per square centimeter is necessary for control of codling moth larvae.

A large number of experiments on the removal of fluorine residue were made, and the earlier finding that hydrochloric acid is still the best wash was confirmed.

The investigation of nicotine residues on apples was continued, and a maximum of 0.026 grain per pound found on some plots. An acid wash reduced this to 0.004, but was not very effective in removing the bentonite that accompanied the nicotine.

Numerous analyses of miscellaneous residues were made for other divisions, including 84 determinations of sulphur on orange leaves sprayed with various sulphur products; nicotine on 3 samples of grapes and on 8 samples of mushrooms, the latter grown in soil drenched with nicotine solutions; barium fluosilicate on 4 samples of peaches; lead and arsenic on 15 samples of peaches and 5 of grapes; and arsenic in 21 samples of soils.

A somewhat related piece of work involved the determination of copper in 800 samples of wood from trees injected with copper sulphate for control of bark beetles, and of zinc, arsenic, and mercury in 300 samples each from trees

injected with zinc chloride, sodium arsenate, and mercuric chloride for the same purpose. These results were needed to show just how the various chemicals spread throughout the trees.

CHEMICAL INVESTIGATIONS TO DEVELOP INORGANIC INSECTICIDES

The investigation of calcium arsenate was actively continued, being directed largely to an attempt to discover the relationship between the chemical and physical characteristics of a given material and its toxicity to both plants and insects. The phase-rule study of the system CaO, As_2O_5, H_2O was completed. This included an approximate evaluation of the concentration limits between which the compounds more basic than dicalcium arsenate can exist at 62° C., and X-ray studies of the samples in the basic region reveal the existence of both tricalcium arsenate and tetracalcium arsenate, with a continuous series of solid solutions between them. A complete analysis was made of the 22 brands of calcium arsenate now on the American market, and the findings of a similar study made several years ago was confirmed, namely, that they all contain some basic arsenate, which in no case is more basic than the formula $4CaO/As_2O_5$. The tests of solubility by a new method recently proposed by the New York Agricultural Experiment Station gave results ranging from 0.2 to 11 percent, revealing the great differences that exist in spite of the apparent uniformity of the generally accepted superficial analysis. The claim that low solubility by the New York method indicates safety to foliage is rather offset by preliminary results, which indicate that three products representing the maximum, mean, and minimum solubilities are all showing considerable injury. The commercial products mentioned were also analyzed mechanically in a new sedimentation apparatus devised for the purpose. Great differences in size-frequency distribution of particle sizes were found, and the insufficiency of the so-called density test for estimating fineness was clearly demonstrated. Portions of a commercially prepared sample of basic calcium arsenate (approximately $4CaO/As_2O_5$), which itself is rather injurious to foliage, were subjected to various degrees of dry and wet heating for various periods. The insect and foliage tests so far made indicate that toxicity to both insects and foliage decreases as the temperature is raised and the time of treatment extended, and that the action is more rapid in the presence of steam. The reason for this inactivation is being studied further.

A survey of the paris greens on the market was also made, the samples obtained being analyzed both chemically and physically. Bibliographies concerning two other minor arsenical insecticides, namely, magnesium arsenate and manganese arsenate, were compiled, and an investigation of the copper and zinc salts of xanthic acid was begun.

CHEMICAL INVESTIGATIONS ON FUMIGANTS FOR CONTROL OF INSECT PESTS

The chemical investigations on fumigants were augmented by the reassignment, on September 1, of a chemist to work with the entomologists of the Bureau stationed at Whittier, Calif., for the study of the problem of the apparent development, by the California red scale on citrus, of a resistance to fumigation with hydrocyanic acid.

It appears from the fumigation tests conducted in the field that no simple relationship exists between scale mortality and concentration of hydrocyanic acid. Protective stupefaction seems to occur, and hence the rate of attainment of maximum concentration is very important. The relationship between maximum concentration and such variables as temperature, humidity, wind velocity, tent porosity, surface volume ratio of tent, etc., proved so complex that it was decided to resort to laboratory experiments under controlled conditions, and two fumigatoriums, of 27 and 850 cubic feet capacity, respectively, have been constructed.

The data on all the tent fumigations so far made have been studied critically, and it has been found that in general the gas concentration decreases logarithmically with time. A consideration of 91 curves shows the rate of decrease to be greater at higher temperatures and with smaller tents, and to become smaller with increasing humidity.

Considerable work was done on the subject of fumigation with nicotine. A technique was developed by which quantities of nicotine from 0.1 to 0.5 milligram can be determined with an accuracy of about 1.5 percent and a suitable air-sampling device was constructed. Samples taken from various parts of a greenhouse in which the vapor from a boiling nicotine solution had been dispersed showed a fairly even distribution, but at a much lower concentration

than expected. This was proved to be due partly to absorption by the water condensed on the windows and elsewhere in the house, and partly to decomposition of the nicotine by contact with the metal of the boiler and exit tube. This decomposition was studied further and found to vary greatly from metal to metal. By simply atomizing a nicotine solution and blowing the spray about, it was found possible to reach a concentration of 0.06 mg of nicotine per liter.

CHEMICAL INVESTIGATIONS ON OILS AND OIL EMULSIONS

The laboratory at Wooster, Ohio, continued the study of oil emulsions and their effect on insects. The greatest attention was paid to the problem of determining the amount of oil deposited on foliage. The investigation of the so-called plate method was completed, it being clearly demonstrated that this simple procedure is not reliable since there is not always a constant relationship between the deposit on the plate and that on the foliage, and when there is, the proportionality constant differs with nature of oil, nature of emulsifier, and even with concentration of oil. However, an extraction method was developed. This method, involving extraction of fresh leaf disks with petroleum ether and subsequent recovery of the extracted oil, appears satisfactory, permitting the determination of both petroleum and fatty oils with an accuracy of ±5 percent or better.

The attempt was also continued to increase the effectiveness of oil sprays by incorporating in them other toxic materials. Of eight materials tried against mealybugs, nicotine and lauryl thiocyanate showed a definite advantage. Of eight materials tested for their effect on eggs of the fruit-tree leaf roller, only nicotine showed any significant increase in kill, and part of this may have been due to increased oil deposit. Of 12 materials tried in pine oil emulsions against overwintering codling moth larvae, only nicotine and alphanaphthylamine showed any promise.

Certain vegetable oils, namely, orange oil, pine oil, peanut oil, corn oil, and cottonseed oil, were compared in emulsion form with petroleum-oil emulsions and all were found to be inferior. The drying oils proved less effective than the nondrying ones, probably because of lesser penetration.

CHEMICAL INVESTIGATIONS ON ACCESSORY MATERIALS FOR USE WITH INSECTICIDES

The study of accessory spray materials, which was begun last year, was continued along three lines, namely, a study of definite soap solutions, a study of proprietary wetting agents, and a study of materials suitable for specific purposes.

The work with soaps included a determination of the surface tensions and spreading coefficients of some of the combinations of oleic, myristic, lauric, palmitic, and normal capric acids with the hydroxides and carbonates of sodium and potassium and with ammonium hydroxide. All the acids behaved qualitatively like oleic, with, however, quantitative differences. The n-caprate mixtures do not have as high wetting powers as do those made from the acids of higher molecular weight, and no caprate mixture showed a positive spreading coefficient. An excess of sodium carbonate has been found in each case to produce less effect upon the wetting properties than an excess of the hydroxide, and oleic acid is less affected by sodium carbonate than are the other acids.

The relationship between concentration on the one hand and both interfacial tension and spreading coefficient on the other was determined for 19 proprietary compounds, many of them being of the sulphated or sulphonated alcohol types which are claimed to be unaffected by acids. It was found that acids and alkalies do have a pronounced effect on the wetting properties, although the compounds are apparently unaffected and are not rapidly decomposed.

Special efforts were made to find suitable wetting agents for the homologues of paris green, for lead arsenate, and for phenothiazine. Certain materials appear suitable for these purposes, but in many cases they cause excessive run-off, and the total deposit obtained is, with lead arsenate, for instance, less than with that material alone. Some evidence indicates that a flocculated spray material may give the heaviest and most uniform deposit.

TESTS TO DETERMINE THE TOXICITY OF NEW INSECTICIDAL COMPOUNDS, USING GOLDFISH

The study of the relationship of toxicity to chemical structure was continued throughout the year. Attention was diverted, however, from the complex ma-

terials previously studied (rotenone and related compounds) to simpler compounds, a study of which was considered more likely to uncover fundamental relationships. The toxicity of phenol was compared with that of phenyl mercaptan or thiophenol, and it was found that in this case the substitution of sulphur, an element of recognized toxic value, for oxygen produces a compound about six times as toxic. Then the three isomeric cresols formed by introducing a CH_3 group into phenol were studied, and it was found that while the meta compound was slightly less toxic, the ortho compound was appreciably more so, and the para compound about twice as toxic as phenol. Finally, the effect of introducing sulphur into these materials to form the corresponding thiocresols was studied. This work has not yet been completed, but it is apparent from the results so far obtained that the meta compound is the least and the para compound the most toxic, as was the case with the cresols themselves. There is thus some indication that the position in which substitutions occur plays a definite part in determining the toxic value.

TRANSIT INSPECTION

The value of transit inspection in connection with the enforcement of the regulations of Federal domestic plant quarantines is definitely shown by the fact that since its establishment by Congress as a project, beginning July 1, 1930, 12,950 violations of the regulations of such quarantines have been intercepted. During the same period over 8,200,000 package shipments were inspected. In other words, a violation of quarantine regulations was found in approximately every 634 shipments inspected.

During the year 15 live adult Japanese beetles were intercepted at midwestern points during the inspection of carloads of fruits and vegetables that had been consigned from the area in New Jersey and Pennsylvania which is heavily infested with the beetle.

Transit inspection is carried out in cooperation with several of the States in which transfer points are located, and with the hearty assistance and support of the employees of the Post Office Department and the railway and express companies. The adequate enforcement of Federal plant quarantine regulations is vital to State protection, and it is expected that many more States will cooperate with the transit inspection project, now that under the recent amendment to the Terminal Inspection Act States which establish terminal plant inspection may return to the consignors shipments that have been mailed in violation of quarantines of the State of destination. Prior to this amendment, authority to return shipments was limited to those sent in violation of Federal plant quarantine regulations, or to those which were infested with an injurious pest and incapable of disinfection.

In tables 24 and 25 it will be noted that during the year 1,151,960 package shipments were inspected for quarantine compliance at 22 points and that 2,269 violations of Federal quarantine regulations were intercepted. The tables include statistics not only for stations where Federal inspection is maintained but also for those worked cooperatively with States or other projects of the Bureau.

TABLE 24.—*Summary of shipments of nursery stock and other plants and plant products inspected in transit during the fiscal year 1936*

Station	Shipments	Carloads	Station	Shipments	Carloads
	Number	*Number*		*Number*	*Number*
Albany	1,643	----------	Omaha and Council Bluffs	38,570	----------
Atlanta	6,645	[1] 17,504	Philadelphia	190,093	----------
Boston	36,807	----------	Pittsburgh	317,339	----------
Buffalo	45,840	----------	Portland, Oreg	30,576	----------
Chicago	76,446	1,000	St. Louis	23,297	----------
Cincinnati	35,322	----------	St. Paul and Minneapolis	76,921	----------
Cleveland	6,885	----------	Seattle	7,423	4
Detroit	38,473	----------	Spokane	13,491	----------
Indianapolis	4,004	----------	Springfield, Mass	4,113	----------
Jacksonville	38,567	[1] 1,020,355	Washington	11,044	----------
Kansas City	12,748	----------			
New York	135,713	----------	Total	[2] 1,151,960	1,038,863

[1] Waybills examined to determine nature of shipment and quarantine status.

[2] Of the above shipments 755,588 were consigned by parcel post, 351,929 by express, and 44,443 by freight.

TABLE 25.—*Shipments of nursery stock and other articles intercepted in violation of Federal plant quarantines*[1] *at transit inspection points, fiscal year 1936*

Station	Shipments intercepted in apparent violation of quarantine—										
	No. 38	No. 45	No. 48	No. 52	No. 53	No. 61	No. 63	No. 64	No. 65	No. 71	Total
	No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Albany		3	1								4
Atlanta		1	8					3			12
Boston		184	116		5						305
Buffalo		1	9		1		12				23
Chicago	3	51	272	3	10	4	14			1	358
Cincinnati		2	11								13
Cleveland											
Detroit		9	9				1				19
Indianapolis		2	3								5
Jacksonville		3	70	1							74
Kansas City			15				3	21			39
New York		152	300		8		4				464
Omaha and Council Bluffs	1	7	112		2		9	1			132
Philadelphia		16	239				6	10	1	1	273
Pittsburgh	1	8	272				5	41			327
Portland, Oreg	4						5				9
St. Louis		1	1				1	58			61
St. Paul and Minneapolis	2		19				24	6			51
Seattle	1		2		42		1				46
Spokane			5		6		3				14
Springfield, Mass		27	7		2		2				38
Washington			1				1				2
Total	12	467	1,472	4	76	4	91	140	1	2	[2] 2,269

[1] Quarantine No. 38 relates to black stem rust; No. 45 to the gypsy moth and brown-tail moth; No. 48 to the Japanese beetle; No. 52 to the pink bollworm; No. 53 to the satin moth; No. 61 to the thurberia weevil; No. 63 to the white-pine blister rust; No. 64 to the Mexican fruitfly; No. 65 to the woodgate rust; and No. 71 to the Dutch elm disease.

[2] The total number of violations represents 2,198 shipments, of which 63 were in violation of 2 quarantines and 4 were in violation of 3 quarantines. In addition to the figures shown in the table of violations, transit inspectors intercepted 125 shipments moving intrastate in apparent violation of State quarantines relating to pests covered also by Federal quarantine. Of these interceptions 1 was made at Albany, 6 at Boston, 13 at Buffalo, 32 at New York, 6 at Philadelphia, 58 at Pittsburgh, 4 at Seattle, 3 at Spokane, and 2 at Springfield.

Many of the important stations are inadequately manned, and no inspection is carried on at several strategic points through which freight, express, and parcel-post shipments are consigned because of the limited amount of funds appropriated for this project.

TERMINAL INSPECTION OF MAIL SHIPMENTS

The law relating to the terminal inspection of parcel-post shipments of plants and plant products was amended on June 4, 1936, by Act No. 643, to allow States which have arranged for terminal inspection of designated plants and plant products to return to the senders consignments which are found on inspection to have been shipped in violation of plant-quarantine laws or regulations of the State of destination. Shipments found on inspection to have been shipped in violation of Federal plant-quarantine laws or regulations, or to be infested with an injurious pest and incapable of disinfection, may also be returned to the sender as heretofore. Terminal inspection was reestablished in Idaho during the year and is also maintained in Arizona, California, the District of Columbia, Florida, Hawaii, Louisiana, Mississippi, Montana, Oklahoma, Oregon, Puerto Rico, Utah, and Washington.

CONVICTIONS AND PENALTIES IMPOSED FOR VIOLATIONS OF THE PLANT QUARANTINE ACT

The following convictions and penalties imposed for violations of the Plant Quarantine Act were reported to the Bureau during the year:

Japanese beetle quarantine: Two convictions, with fines aggregating $45.

Gypsy moth and brown-tail moth quarantine: One conviction, with fine of $30.

Quarantines affecting Mexican plants and plant products: Fines aggregating $247.65 were imposed by customs officials on the Mexican border against 245 persons caught attempting to smuggle in from Mexico prohibited plants and plant products.

Quarantines affecting Canadian plants and plant products: A fine of $15 was imposed by a customs official on the Canadian border against one person caught attempting to smuggle in from Canada prohibited plants.

FOREIGN PLANT QUARANTINES

The Division of Foreign Plant Quarantines is engaged in the enforcement of quarantines and regulatory orders of the Department prohibiting or restricting the entry of various plants and plant products into the United States and, in addition, the enforcement of such domestic quarantines as affect the movement of plant material between the Territories of Hawaii and Puerto Rico and continental United States. The number of quarantines involved during the year remained the same as last fiscal year, namely, 24 foreign plant quaratines and regulatory orders, 8 domestic plant quarantines, and 4 miscellaneous regulatory measures.

Plant-quarantine inspectors and collaborators are stationed at the more important ports of entry and at points distributing foreign mail and work in close cooperation with employees of the Treasury and Post Office Departments.

Detailed information on the various quarantines and regulatory orders is available in other publications. Enforcement activities are summarized in the succeeding sections of this report, accompanied by tables presenting in condensed form records indicating the scope of the work and the results obtained.

RECORDS OF IMPORTS OF RESTRICTED PLANTS AND PLANT PRODUCTS

Under the various foreign quarantines and orders certain plants and plant products are restricted as to entry and are subject to inspection and, if necessary, disinfection for the purpose of excluding plant diseases and insect pests. Among such restricted plants and plant products are nursery stock, plants, bulbs, and seeds; fruits and vegetables; grains from certain countries; cotton, cotton waste, cotton wrappings (bagging), and cottonseed products; cottonseed, seed cotton, and cottonseed hulls from the Imperial Valley, Baja California, Mexico; bagasse; and certain packing materials. A record is given of the importation of the products inspected by inspectors of the Bureau and, if necessary, treated under their supervision.

IMPORTATIONS OF NURSERY STOCK, PLANTS, BULBS, AND SEEDS

The importations recorded in tables 26 to 28 were entered under permit, subject to inspection and treatment, when necessary, under regulation 3 of Quarantine No. 37.

TABLE 26.—*Importation of fruit and nut cuttings and scions and of rose stocks under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1936*

[Figures indicate actual number of propagating units]

Kind of material	Austria	Belgium	Canada	England	France	Germany	Hungary	Italy	Netherlands
Cuttings and scions:									
Apple			1,233	90		202			
Apricot						10			
Cherry			9					10	
Fig								450	
Grape	140	52			16		522		
Nut			233					13	
Pear			16			102			
Plum			49						
Prunus sp						10			
Rose stocks				1,109,304		10,000			6,290,137
Total	140	52	1,540	1,109,394	16	10,324	522	473	6,290,137

TABLE 26.—*Importation of fruit and nut cuttings and scions and of rose stocks under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1936*—Continued

Kind of material	Northern Ireland	Poland	Portugal	Rumania	Trinidad	Union of Soviet Socialist Republics	Yugoslavia	Total
Cuttings and scions:								
Apple		107						1,632
Apricot						14		24
Cherry		150				83		252
Fig							365	815
Grape			3	14			7	754
Nut								246
Passiflora					10			10
Peach						7		7
Pear		119						237
Plum		50				44		143
Prunus sp						10		20
Rose stocks	43,000							7,452,441
Total	43,000	426	3	14	10	158	372	7,456,581

TABLE 27.—*Importation of bulbs under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1936*

Kind of bulbs	Belgium	Bermuda	Bulgaria	Canada	China	Denmark	England	France	Germany	Greece	India	Irish Free State
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Chionodoxa				1								
Convallaria				39			25		7,400,250			
Crocus	100			870		4	100					
Eranthis							48					
Fritillaria	2											
Galanthus						11	7,567		49			
Hyacinth	20	4,000		213				411,750				
Ixia							100					
Lily	20	311,175	9	3,856	6,400		2,924	585,758			955	100
Muscari				25			600					
Narcissus [1]					13,859							
Scilla	100						652					
Tulip	100			1,678		10	38,674	71,000		39		
Total	342	315,175	9	6,682	20,259	25	50,690	1,068,508	7,400,299	39	955	100

Kind of bulbs	Italy	Japan	Netherlands	Northern Ireland	Scotland	Switzerland	Turkey	Union of South Africa	Yugoslavia	Total
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Chionodoxa			539,761							539,762
Convallaria		14,000	67,185							7,481,499
Crocus	173	2,003	8,721,434		37		30		126	8,724,877
Eranthis		10	307,039							307,097
Fritillaria			218,331		2					218,335
Galanthus			781,799	80	12	7	141,000			930,525
Hyacinth		3	13,761,077				10		6	14,177,079
Ixia		3,000	236,173					60		239,333
Lily	80,460	18,248,531	1,440,812	6	5				2	20,681,013
Muscari			1,376,014				10		32	1,376,681
Narcissus [1]										13,859
Scilla	2	3	1,761,053							1,761,810
Tulip	14	42,205	76,306,353			3	17		48	76,460,141
Total	80,649	18,309,755	105,517,031	86	56	10	141,067	60	214	132,912,011

[1] Narcissus imported under regulation 3 of Quarantine No. 37 are limited to importations of the Chinese sacred lily (*Narcissus tazetta* var. *orientalis*), the entry of which is permitted into the Hawaiian Islands for local use and distribution in those islands only.

TABLE 28.—*Importation of seeds under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1936* [1]

Country	Apple	Apricot	Cherry	Elm	Nut and palm	Ornamental and tree
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Argentina					4	19
Australia					28,448	18
Austria	570		1,168		5	3,544
Belgian Congo					1	1
Belgium						92
Brazil					212	28
British Guiana					14	2
Canada	4		5		291	12,360
Canal Zone					10	7
Canary Islands						10
Ceylon					3	
Chile						4
China				340	851	2,159
Colombia					2	10
Cuba						14
Czechoslovakia	48		2			14,234
Denmark						830
Dominica					1	
Dominican Republic					55	
England					2	4
France	5,672		4,415		44	625
Germany		1				5,586
Gold Coast					1	
Guam					2	
Guatemala					2	
Honduras						1
India		1			1	171
Italy			200			1,452
Jamaica						2
Japan	4		2	240	870	3,772
Java					3	
Manchuria				5	55	794
Mauritius					5	
Mexico					4	11
Netherland India					2	1
Netherlands						21
New Zealand						51
Peru						2
Philippine Islands					3	2
Poland						22
Portugal						1
Rhodesia						2
Samoa						3
Scotland						173
Sierra Leone						1
Society Islands					4	
Spain						1
Straits Settlements					1	
Sweden						2
Trinidad					3	2
Union of South Africa					4	27
Union of Soviet Socialist Republics						33
Yugoslavia			661			
Total	6,298	2	6,453	585	30,903	46,094

[1] In addition to the importations indicated in this table, the following seeds were imported: Into continental United States, 480 small mail packets of miscellaneous seeds from 56 foreign countries and 2 test tubes of orchid seedlings from Germany; into Puerto Rico, 12,536 pounds and 2 packets of ornamental and tree seeds from Canal Zone, Dominican Republic, Guadeloupe, Haiti, India, Mexico, Palestine, and Venezuela; and into Hawaii, 77 pounds and 5 packets of nut and palm seeds, 30 pounds and 15 packets of ornamental and tree seeds, and 5 packets of miscellaneous seeds from Australia, Barbados, Canal Zone, Ceylon, China, Cuba, Ecuador, Egypt, India, Japan, Java, New Zealand, Philippines, Seychelles, Straits Settlements, Trinidad, Union of South Africa, and Venezuela.

TABLE 28.—*Importation of seeds under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1936*—Continued

Country	Pear	Persimmon	Plum	Quince	Rose	Miscellaneous	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Argentina							23
Australia							28,466
Austria	484		924	3	36		6,734
Belgian Congo							2
Belgium							92
Brazil							240
British Guiana							16
Bulgaria	1						1
Canada			120		10		12,790
Canal Zone							17
Canary Islands							10
Ceylon							3
Chile							4
China							3,350
Colombia							12
Cuba							14
Czechoslovakia	12		108		15		14,419
Denmark							830
Dominica							1
Dominican Republic							55
England							6
France	712		65	50			11,583
Germany					15		5,602
Gold Coast							1
Guam							2
Guatemala						1	3
Honduras							1
India						2	175
Italy							1,652
Jamaica							2
Japan	829	164			746		6,627
Java							3
Manchuria	37	2	1		76		970
Mauritius							5
Mexico						26	41
Netherland India							3
Netherlands							21
New Zealand							51
Peru							2
Philippine Islands							5
Poland							22
Portugal							1
Rhodesia							2
Samoa							3
Scotland							173
Sierra Leone							1
Society Islands							4
Spain							1
Straits Settlements							1
Sweden							2
Trinidad							5
Union of South Africa							31
Union of Soviet Socialist Republics							33
Yugoslavia							661
Total	2,075	166	1,218	53	898	29	94,774

In addition to the bulbs recorded in table 27, there were imported for propagation under item 6 of this regulation, under permit subject to inspection, 10 pounds of ginger roots, 7 of cipollini, 3 pounds of dasheens, and 20 oxalis bulbs. The 50 pounds of onion sets which were also imported under item 6 are in marked contrast with the onion-set importations of 1935; during 1935 1,832,291 pounds of this commodity were imported from Greece alone.

In addition to the foregoing there were imported during the year from the Dominion of Canada, under regulation 15 of Quarantine No. 37, 1,192,941 bulbs, plants, trees, and cuttings, as compared with 875,492 during the fiscal year 1935. To authorize the importation of this material, 817 permits were issued, as compared with 859 issued in 1935.

The record of entry under special permits issued under the provisions of regulation 14 of Quarantine No. 37 for the purpose of keeping the country supplied with new varieties and necessary propagating stock and for educational, experimental, or scientific purposes is shown by States in table 29. A total of 3,273,621 plants, bulbs, cuttings, etc., were imported, as compared with 2,624,694 in 1935. Increased importations were noted in all classes except narcissus, rose, and fruit, which decreased. The largest rate of increase is in importations of gladiolus; 637,908, or 332 percent, more gladiolus corms and cormels were imported in 1936 than in 1935. The largest rate of decrease is in rose; 22,961, or 77 percent, less rose plants and cuttings were imported in 1936 than in 1935. In 1936 more special permits were issued than in 1935, or any other previous year since Quarantine No. 37 was promulgated. The increase in the number of importations authorized entry as cargo and baggage brought about a decrease in the authorization for entry of this material by mail from 63 percent of the total in 1935 to approximately 57 percent in 1936.

TABLE 29.—*Distribution, by States, showing plants, bulbs, and other materials, of special-permit material imported during the fiscal year 1936*

State or Territory	Dahlia	Gladiolus	Iris, bulbous	Iris, rhizomatous	Narcissus	Orchid	Peony
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Alabama			240,600				
Arkansas		15					
California	2,756	81,217	150,040	257	539	9,705	2,163
Colorado		41,232		13		50	
Connecticut	18	20,010		12		509	31
Delaware					130	179	78
District of Columbia				3	207	13	
Florida		15,000	29	1	1	2,157	
Georgia				23		25	
Hawaii		5,000		100		1,601	
Idaho		62					
Illinois	734	69,830	50,000	38		181	28
Indiana	44	13,805			6	3	19
Iowa		25,506					36
Kentucky	71						
Louisiana						482	
Maine	31						
Maryland		17,275	150,850		47,197	53	
Massachusetts	563	23,132		147		2,145	
Michigan	172	55,157	5	19	275	19	19
Minnesota	211	11,997	18	118	2		
Mississippi			4,409	41			8
Missouri	24		50,000			161	20
Montana	11						
Nebraska	6						
New Hampshire	50	54,000	59		192	50	1
New Jersey	998	74,993	149,250	316	112	4,969	47
New York	1,521	131,478	88,560	1,095	82,279	3,028	70
North Carolina		60,098	422,000	10	87,514	216	
North Dakota		53,752					
Ohio	869	5,417	310	126	210	445	161
Oklahoma						6	
Oregon	479	44,872		26	4,625	57	17
Pennsylvania	131	4,031	30,000		1,765	1,619	140
Puerto Rico	42					651	
Rhode Island	210	7,538			750	50	
South Carolina		54				3	
South Dakota					17		
Tennessee			1,250		242		15
Texas			4,000				
Vermont		11,741				39	
Virginia	133		10,000	72	108	3	
Washington	406	922	240,480	251	12,210	19	494
West Virginia	25				50		
Wisconsin	358	1,949				191	11
Total	9,863	830,083	1,591,860	2,668	238,431	28,629	3,358

TABLE 29.—*Distribution, by States, showing plants, bulbs, and other materials, of special-permit material imported during the fiscal year 1936*—Continued

State or Territory	Rose	Fruit	Herbaceous	Miscellaneous bulbs, roots, etc.	Ornamental	Total
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Alabama				35	79	240,714
Arizona					10	10
Arkansas						15
California	102	23	737	43,680	23,213	314,432
Colorado			1,009	325	752	43,381
Connecticut	116		486	220	2,274	23,676
Delaware				75	10	472
District of Columbia			21		46	290
Florida			41	2,486	46,913	66,628
Georgia	464				230	742
Hawaii		284		386	130	7,501
Idaho						62
Illinois	40		396	749	275	122,271
Indiana	123			216	24	14,240
Iowa			30	40	5	25,617
Kansas					1	1
Kentucky				11		82
Louisiana			40		3,126	3,648
Maine					3	34
Maryland			437	10,082	2,067	227,961
Massachusetts	129	81	2,275	707	640	29,819
Michigan	7		637	22	42	56,374
Minnesota		7		4,800	24	17,177
Mississippi		9		32		4,499
Missouri	96	6		3	2,088	52,398
Montana						11
Nebraska						6
New Hampshire	10		27	85	45	54,519
New Jersey	1,211	423	11,254	2,362	57,719	303,654
New Mexico					41	41
New York	3,571	95	14,647	55,387	210,913	592,644
North Carolina		12	36	8	133	570,027
North Dakota						53,752
Ohio	87	36	4,800	6,764	1,793	21,018
Oklahoma				196		202
Oregon	164	400	41	209	166	51,056
Pennsylvania	757	106	66	1,671	4,290	44,576
Puerto Rico	23	122	28	31	2,117	3,014
Rhode Island			19,950	111	30	28,639
South Carolina			1	16	200	274
South Dakota						17
Tennessee				1,275	141	2,923
Texas	60		3	6	2,232	6,301
Vermont					16	11,796
Virginia	40		1	86	18	10,461
Washington	48	40	277	6,374	463	261,984
West Virginia	5				350	430
Wisconsin		25	1,404	37	257	4,232
Total	7,053	1,669	58,644	138,487	362,876	3,273,621

IMPORTATIONS OF COTTON, COTTON WRAPPINGS (BAGGING), COTTONSEED, COTTONSEED HULLS, AND COTTONSEED PRODUCTS

Tables 30 to 33 indicate the importations during the year of cotton, cotton waste, cotton wrappings (bagging), cottonseed, cottonseed hulls, and cottonseed products, which were inspected and, when necessary, fumigated or otherwise treated under supervision. The actual number of bales of cotton, cotton waste, and bagging is indicated and, inasmuch as bales vary in size, they are referred to as running bales.

TABLE 30.—*Importation of running bales of ginned cotton, by country of growth and port of entry, fiscal year 1936*

Country	Baltimore	Boston	Buffalo	Calexico	El Paso	Galveston	Houston	Mobile	New Orleans	Newport
Anglo-Egyptian Sudan		6,685								
Brazil		392								
China		4,065								
Egypt		24,713								
India		13,808								
Mexico		2		13,650	524					
Peru		195								
United States (returned)		195	18			96	2	2	140	779
Unknown	186									
Total	186	50,055	18	13,650	524	96	2	2	140	779

Country	New York	Niagara Falls	Norfolk	Portland	Saint Albans	San Francisco	San Pedro	Seattle	Total
Anglo-Egyptian Sudan	5								6,690
Argentina	25								25
Brazil	10,569			375		3,315	1,370	677	16,698
China	3,700			357		10,291	4,237	1,825	24,475
Ecuador	108								108
Egypt	12,800								37,513
India	41,313			84		1,027	2,287	300	58,819
Mexico	4,578					1,206	2,107	128	22,195
Netherland India	510					547		1	1,058
Paraguay	50								50
Peru	1,049								1,244
Puerto Rico	210								210
Turkey	5								5
Union of Soviet Socialist Republics	414								414
United States (returned)		387			24				1,643
Unknown			1,383						1,569
Total	75,336	387	1,383	816	24	16,386	10,001	2,931	[1]172,716

[1] Includes 38,047 bales of linters.

TABLE 31.—*Importation of running bales of cotton waste, by country of origin and port of entry, fiscal year 1936*

Country	Baltimore	Boston	Buffalo	Charleston	Detroit	Galveston	Houston	Island Pond	New Orleans	Newport	New York	Niagara Falls
Argentina		2									149	
Belgium		842									4,553	
Brazil	10										186	
Canada		164	396		364			124		128		133
China	695	1,274									23,192	
Colombia											232	
England		10,908				48					3,897	
France	2	1,452									2,449	
Germany		130									3,068	
India		1,110									20,343	
Japan	650	3,385		50			220		50		33,222	
Mexico									169		5	
Netherlands		120		29							1,507	
Scotland		236									275	
Spain											2,313	
Switzerland											138	
United States (returned)												66
Total	1,357	19,623	396	79	364	48	220	124	219	128	95,529	199

TABLE 31.—*Importation of running bales of cotton waste, by country of origin and port of entry, fiscal year 1936*—Continued

Country	Norfolk	Philadelphia	Port Huron	Portland	Richford	Rouses Point	Saint Albans	San Francisco	San Pedro	Savannah	Seattle	Total
Argentina												151
Belgium												5,395
Brazil	22	61										279
Canada			457		23	302	1,669					3,760
China		4,335						3,414	1,089	200		34,199
Colombia												232
England	100	441						310				15,704
France								297				4,200
Germany												3,198
India		627						605				22,685
Japan	284	6,623		367				6,025	1,644	1,294	7,184	60,998
Mexico												174
Netherlands		199						227	85			2,167
Peru									15			15
Scotland	54	29										594
Spain		17										2,330
Switzerland												138
United States (returned)												66
Total	460	12,332	457	367	23	302	1,669	10,878	2,833	1,494	7,184	156,285

TABLE 32.—*Importation of running bales of bagging, by country of origin and port of entry, fiscal year 1936*

Country	Baltimore	Beaumont	Boston	Buffalo	Charleston	Chicago	Detroit	Galveston	Houston	Lake Charles	Malone	Mobile	New Orleans
Austria													189
Belgium	702		1,226					1,093	1,131				1,000
Canada			1,472	351		2	5,867				67		
Canal Zone													18
China					411								
Cuba	21							786	50				116
Egypt			110										
England	817	1,714	646					14,749	2,396			220	1,638
France	261		1,297					1,662	1,737			349	1,531
Germany			136					140	440				
India	60								236				180
Ireland			49										
Italy									338				812
Japan	2,500		2,000		2,600			3,640	3,373				5,253
Netherlands	57		2					508	712	1,200			334
Norway													1,200
Portugal								192	105				192
Scotland			73					991	133				
Spain	120								157				46
Total	4,538	1,714	7,011	351	3,011	2	5,867	23,761	10,808	1,200	67	569	12,509

TABLE 32.—*Importation of running bales of bagging, by country of origin and port of entry, fiscal year 1936*—Continued

Country	Newport	New York	Niagara Falls	Norfolk	Philadelphia	Port Huron	Rochester	Rouses Point	Saint Albans	San Francisco	San Pedro	Savannah	Total
Algeria	----	48	-----	-------	-----	-----	----	----	----	-----	-----	-----	48
Anglo-Egyptian Sudan	----	480	-----	-------	-----	-----	----	----	----	-----	-----	-----	480
Argentina	----	1,551	-----	-------	-----	-----	----	----	----	-----	-----	-----	1,551
Austria	----	-------	-----	-------	-----	-----	----	----	----	-----	-----	-----	189
Belgium	----	10,198	-----	2,567	-----	-----	----	----	----	-----	-----	147	18,064
Canada	253	400	2,635	-------	-----	1,977	351	334	735	-----	-----	-----	14,444
Canal Zone	----	-------	-----	-------	-----	-----	----	----	----	-----	-----	-----	18
China	----	307	-----	-------	204	-----	----	----	----	-----	409	-----	1,331
Cuba	----	82	-----	-------	-----	-----	----	----	----	-----	-----	-----	1,055
Czechoslovakia	----	39	-----	-------	-----	-----	----	----	----	-----	-----	-----	39
Denmark	----	416	-----	-------	-----	-----	----	----	----	-----	-----	-----	416
Egypt	----	4,648	-----	-------	-----	-----	----	----	----	-----	-----	-----	4,758
England	----	3,922	-----	4,488	3,439	-----	----	----	----	-----	-----	-----	34,029
France	----	7,347	-----	2,195	45	-----	----	----	----	-----	-----	435	16,859
Germany	----	948	-----	956	-----	-----	----	----	----	-----	-----	-----	2,620
Greece	----	74	-----	-------	-----	-----	----	----	----	-----	-----	-----	74
India	----	3,483	-----	100	-----	-----	----	----	----	-----	-----	-----	4,059
Ireland	----	107	-----	-------	-----	-----	----	----	----	-----	-----	-----	156
Italy	----	1,602	-----	-------	-----	-----	----	----	----	-----	-----	-----	2,752
Japan	----	9,782	-----	4,747	800	-----	----	----	----	3,078	2,402	1,200	41,375
Luxemburg	----	19	-----	-------	-----	-----	----	----	----	-----	-----	-----	19
Netherlands	----	10,134	-----	1,669	-----	-----	----	----	----	-----	-----	-----	14,616
Norway	----	-------	-----	-------	-----	-----	----	----	----	-----	-----	-----	1,200
Poland	----	2,739	-----	506	-----	-----	----	----	----	-----	-----	-----	3,245
Portugal	----	220	-----	-------	-----	-----	----	----	----	-----	-----	-----	709
Puerto Rico	----	1,908	-----	-------	-----	-----	----	----	----	-----	-----	-----	1,908
Rumania	----	46	-----	-------	-----	-----	----	----	----	-----	-----	-----	46
Scotland	----	3,892	-----	-------	-----	-----	----	----	----	-----	-----	-----	5,089
Spain	----	12,247	-----	-------	-----	-----	----	----	----	-----	-----	-----	12,570
Sweden	----	147	-----	-------	-----	-----	----	----	----	-----	-----	-----	147
Switzerland	----	254	-----	73	-----	-----	----	----	----	-----	-----	-----	327
Union of Soviet Socialist Republics	----	214	-----	-------	-----	-----	----	----	----	-----	-----	-----	214
Total	253	77,254	2,635	17,301	4,488	1,977	351	334	735	3,078	2,811	1,782	[1] 184,407

[1] Includes 5,646 bales of cotton-contaminated rags restricted in same manner as foreign cotton covers.

TABLE 33.—*Importation of cottonseed, cottonseed hulls, and cottonseed products, fiscal year 1936*

Port	Cottonseed[1]	Cottonseed hulls [1]	Cottonseed cake	Cottonseed meal	Cottonseed oil
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Gallons*
Boston	----------	----------	----------	3,300	----------
Brownsville	----------	----------	25,678	----------	10
Calexico	11,000	18,918,375	----------	----------	----------
El Paso	----------	----------	307,841	490,693	24,795
Hidalgo	----------	----------	6,775	----------	10
Laredo	----------	----------	324,236	215,584	1
New York	----------	----------	----------	5	----------
Nogales	----------	----------	4	----------	----------
Puerto Rico (all ports)	----------	----------	----------	55,115	----------
San Francisco	----------	----------	2	----------	----------
Total	11,000	18,918,375	664,536	[2] 764,697	24,816

[1] Cottonseed and cottonseed hulls are permitted entry only from the Imperial Valley, Baja California, Mexico.

[2] Includes 55,115 pounds of fertilizer composed principally of cottonseed meal.

In addition, the Bureau supervised the entry of 25,126 parcels of samples of cotton, cotton linters, cotton waste, and bagging imported by freight, express, and parcel post, and as passenger baggage.

The importations of cotton, cotton waste, and bagging show increases over last year's importations, as follows: Cotton, 10; cotton waste, 22; and bagging, 51 percent. The figure for bagging includes 5,646 bales of rags contaminated with cotton in its various forms. Because of this contamination entry was permitted subject to compliance with the entry requirements imposed by the cotton regulations on foreign cotton covers. The importations of cottonseed cake, meal, and oil show a decided decrease from last year's unprecedentedly heavy importations. Of outstanding interest, however, are the large importations of cottonseed hulls, 18,918,375 pounds, and bolly hulls for fertilizer, 4,320,000 pounds, from the Imperial Valley, Baja California, Mexico, the only area from which such commodities may enter the United States.

IMPORTATIONS OF GRAIN, BROOMS, AND BROOMCORN

Table 34 shows the importations of shelled corn inspected under the provisions of Quarantine No. 41, and table 35 shows the importations of brooms and broomcorn.

TABLE 34.—*Importation of clean shelled corn under Quarantine No. 41, by country of growth, fiscal year 1936*

Country	Pounds	Country	Pounds	Country	Pounds
Argentina	642,020,745	Guatemala	1	Union of South Africa	19,465,436
Brazil	54	Haiti	5,000	United States (returned)	99,450,840
Canada	4,169,313	Hungary	39,240		
Cuba	398,790	Kenya	5,687,136		
Dominican Republic	12,287,469	Mexico	3,817,153		
England	2	Paraguay	2,240,000	Total	789,581,179

TABLE 35.—*Importation of brooms and broomcorn under Quarantine No. 41, by country of origin, fiscal year 1936*

Country	Brooms	Broomcorn	Country	Brooms	Broomcorn
	Number	*Bales*		*Number*	*Bales*
Argentina	----------	1,949	Mexico	6,239	298
Hungary	6,912	----------			
Japan	2	----------	Total	13,153	2,247

In addition inspection was made under Quarantine No. 41, which restricts the importation of corn and related plants, of seeds of related plants, 802 pounds; corn on the cob, green, 47,147 pounds.

The Bureau also supervised the entry under Quarantine No. 55 of rice straw, 1,855 bales and 5 bundles; articles made of rice straw, 5,064; and seed or paddy rice, 31 pounds.

The importations under Quarantine Nos. 24, 41, and 55 show a decided decrease from last year's importations. No shipments by freight or express were made under Quarantine No. 24. The importations of shelled corn under Quarantine No. 41 continued heavy, however, and represent the second largest since shelled corn was placed under restriction by that quarantine on January 1, 1927. Special provision has been made for the entry of parcel-post shipments of shelled corn and seeds of related plants. The figures in tables 34 and 35 include such parcel-post shipments.

IMPORTATION OF BAGASSE UNDER QUARANTINE NOS. 15 AND 16

Importations of bagasse from foreign countries under Quarantine No. 15 totaled 29,274 bales and 9 parcels. Only 6 pounds were shipped to continental United States under Quarantine No. 16.

IMPORTATIONS OF FRUITS AND VEGETABLES

Tables 36 and 37 show by countries of origin and ports of entry, respectively, the kinds and quantities of fruits and vegetables imported into the continental United States and into Hawaii and Puerto Rico during the fiscal year under permit and subject to inspection at the port of first arrival under the provisions of Quarantine No. 56, as well as importations of mandarin oranges under Quarantine No. 28 and potatoes under the regulations governing the importation of potatoes into the United States. The total of these importations is 52,972,203 bunches of bananas, 932,538 crates of pineapples, and 246,126,255 pounds of all other commodities listed. On the basis of weight this year's importations show a slight increase over those of the preceding year. In addition, 1,182 emergency permits were issued for the entry as passengers' baggage of small lots of fruits and vegetables of the kinds previously approved for entry at the ports involved.

TABLE 36.—*Fruits and vegetables imported, by countries of origin, fiscal year 1936*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Country and quantity	Total
Apple—pounds	Argentina, 4,077; Chile, 390; Denmark, 100	4,567
Apricot—do	Chile, 14,102	14,102
Aralia cordata—do	Japan, 1,625	1,625
Arrowhead—do	China, 153,997; Japan, 25	154,022
Artichoke, Jerusalem—do	Mexico, 5	5
Asparagus—do	Argentina, 73,366; Mexico, 34	73,400
Avocado—do	Cuba, 9,532,261; Mexico (seeds removed), 49,804	9,582,065
Balsamapple—do	Cuba, 16,887; Mexico, 2,319	19,206
Banana—bunches	British Honduras, 441,974; Colombia, 3,885,027; Costa Rica, 3,449,882; Cuba, 4,603,814; Dominican Republic, 7,786; Ecuador, 1,356,455; Guatemala, 6,455,280; Haiti, 534,225; Honduras, 9,688,024; Jamaica, 441,421; Mexico, 13,338,814; Nicaragua, 2,245,473; Panama, 6,524,024; Virgin Islands, 3; Venezuela, 1.	52,972,203
Bean (green):		
Faba—pounds	Mexico, 116	116
Lima—do	Cuba, 6,571,506; Mexico, 28,311	6,599,817
String—do	Cuba, 490; Mexico, 1,119,346	1,119,836
Beet—do	Mexico, 185,564	185,564
Berry:		
Rubus—do	Mexico, 8; Norway, 2,054	2,062
Vaccinium—		
Frozen—do	England, 364; Newfoundland, 3,155,005	3,155,369
Natural—do	Estonia, 290,966; Newfoundland, 1,226,330; Norway, 110; Sweden, 340.	1,517,746
Breadfruit—do	Cuba, 1,216	1,216
Brussels sprouts—do	Mexico, 9; Netherlands, 216	225
Cabbage—do	Cuba, 383; Dominican Republic, 322; Mexico, 27,368.	28,073
Cacao bean pod—do	Costa Rica, 176; Trinidad, 135	311
Carrot—do	Mexico, 540,123	540,123
Cassava—do	Cuba, 190,066; Dominican Republic, 50	190,116
Cauliflower—do	Mexico, 2,516	2,516
Celery—do	Bermuda, 3,560; Cuba, 29; Mexico, 108	3,697
Chayote—do	Cuba, 19,243; Mexico, 2,643	21,886
Cherry:		
Dried, sour—do	Yugoslavia, 45,172	45,172
Fresh—do	Argentina, 440; Chile, 5,999	6,439
Chinese cabbage—do	Cuba, 48,757; Mexico, 980	49,737
Cipollino—do	Italy, 441; Morocco, 1,831,300	1,831,741
Citrus medica—do	Albania, 1,625; Italy, 1,620; Palestine, 14,589	17,834
Clover top—do	Mexico, 668	668
Coriander—do	Mexico, 299	299
Crescentia alata—do	Mexico, 3	3
Crosnes—do	Belgium, 220	220
Cucumber—do	Cuba, 2,502,760; Mexico, 17,564	2,520,324
Dasheen (includes colocasia, inhame, malanga, taro, and yautia), pounds.	Azores, 258,745; China, 331,978; Cuba, 128,477; Dominican Republic, 767,973; Honduras, 25; Japan, 86,510; Mexico, 116.	1,573,824
Eggplant—do	Cuba, 8,333,149; Jamaica, 1,472; Mexico, 311,986	8,646,607
Endive—do	Belgium, 1,266,486; Netherlands, 25,665	1,292,151
Euphorbia longana—do	Cuba, 226	226
Garlic—do	Canary Islands, 2,976; Chile, 2,150,461; China, 5,550; Cuba, 15; Japan, 910; Mexico, 2,813,498; New Zealand, 10,080; Spain, 1,902,392.	6,885,882

TABLE 36.—*Fruits and vegetables imported, by countries of origin, fiscal year 1936*—Continued

Kind	Country and quantity	Total
Genip (*Melicocca bijuga*)---pounds	Cuba, 150	150
Ginger (crude)---do	China, 386,008; Cuba, 9,536; Japan, 300; Mexico, 3	395,847
Grape:		
Fresh (not hothouse)---do	Argentina, 11,339,949; Chile, 1,063,634; Mexico, 8,900; Spain, [1] 170,936.	12,583,419
Hothouse---do	Belgium, 88,253; England, 55	88,308
Processed---do	Italy, 6,600	6,600
Grapefruit---do	Cuba, 4,038,166; Haiti, 24,836; Jamaica, 40	4,063,042
Husk tomato---do	Mexico, 10,102	10,102
Japanese horseradish---do	Japan, 316	316
Kale---do	Bermuda, 146,940	146,940
Kohlrabi---do	Cuba, 150; Mexico, 566	716
Kudzu---do	China, 62,632; Cuba, 495	63,127
Lemon---do	Argentina, 1; Guatemala, 100; Honduras, 450; Italy 6,395,670.	6,396,221
Lettuce---do	Mexico, 42,831	42,831
Lily bulb (edible)---do	China, 25,065; Japan, 50	25,115
Lime (sour)---do	Antigua, 1,200; British Honduras, 50; Costa Rica, 890; Cuba, 139,441; Dominica, 515,927; Dominican Republic, 141,366; Grenada, 3,600; Guatemala, 20; Haiti, 20,117; Honduras, 8,190; Jamaica, 517,498; Mexico, 9,620,374; Montserrat, 172,650; St. Lucia, 837,390; Trinidad, 72,808; Virgin Islands, 17,002.	12,068,523
Litchi nut---do	Cuba, 134	134
Mango (frozen, seed removed)---do	Philippine Islands, 335	335
Melon---do	Argentina, 114,356; Chile, 4,001,676; Mexico, 341,630; Peru, 13,206; Spain, 1,176,223.	5,647,091
Mint---do	Cuba, 290; Mexico, 40	330
Mustard---do	Cuba, 46,382; Mexico, 101,398	147,780
Nectarine---do	Chile, 652,328	652,328
Nectarine (hothouse)---do	Belgium, 25	25
Nopale---do	Mexico, 882	882
Nuts:		
Acorn---do	Albania, 384,990; Greece, 620,163; Turkey, 10,430,813	11,435,966
Chestnut---do	China, 66,420; Italy, 13,976,329; Japan, 503,153; Portugal, 1,344,175; Spain, 177,128.	16,067,205
Okra---do	Cuba, 1,797,452; Mexico, 43,109	1,840,561
Onion---do	Australia, 209,190; Bermuda, 710; Chile, 607,604; China, 300; Italy, 2,789,065; Jamaica, 40; Japan, 330; Mexico, 142,715; Netherlands, 40,320; Portugal, 500; Spain, 387,799; Virgin Islands, 530.	4,179,103
Orange:		
Under Quarantine No. 56---do	Cuba, 7,870	7,870
Mandarin (Quarantine No. 28)---do	Japan, 2,303,797	2,303,797
Papaya---do	Cuba, 142,509	142,509
Parsley---do	Mexico, 10,725	10,725
Pea---do	Cuba, 3,253; Mexico, 2,997,440	3,000,693
Peach---do	Argentina, 26,026; Chile, 105,351	131,377
Pear---do	Argentina, 638,406; Chile, 119,170	757,576
Pepper---do	Bahamas, 180; Cuba, 5,745,336; Haiti, 120; Mexico, 5,662,484; Virgin Islands, 100.	11,408,220
Pigweed---do	Mexico, 897	897
Pineapple---crates	Antigua, 1; British Honduras, 3; Costa Rica, 1,196; Cuba, 767,636; Dominica, 78; Dominican Republic, 852; Haiti, 158; Honduras, 190; Mexico, 162,424.	932,538
Plantain---pounds	British Guiana, 100; Britisb Honduras, 234,145; Costa Rica, 15,770; Cuba, 3,330,012; Dominican Republic, 6,732,845; Guatemala, 300; Haiti, 1,158; Honduras, 229,205; Mexico, 293,554; Panama, 366,640; Venezuela, 104,250.	11,307,979
Plum---do	Argentina, 33,323; Chile, 78,759	112,082
Potato:		
Under QuarantineNo. 56---do	Bermuda, 1,061,427	1,061,427
Under potato regulations---do	Canary Islands, 40,176; Cuba, 2,650,355; Mexico, 162,525; Spain, 36,927.	2,889,983
Pricklypear---do	Mexico, 2,840	2,840
Pumpkin---do	Cuba, 166,230; Dominican Republic, 100,901; Mexico, 16,259.	283,390
Purslane---do	Mexico, 1,656	1,656
Radish---do	Cuba, 24,244; Mexico, 145,553	169,797
Rhubarb---do	Mexico, 5	5
St. Johns bread---do	Cyprus, 1,108,637; Greece, 324,651; Italy, 33,034; Portugal, 90; Spain, 10.	1,466,422
Salsify---do	Mexico, 2,985	2,985
Spinach---do	Cuba, 93; Mexico, 67,522	67,615
Squash---do	Cuba, 57,724; Mexico, 140,022	197,746
Strawberry---do	Cuba, 10; Mexico, 19,868	19,878

[1] Sterilized by refrigeration.

TABLE 36.—*Fruits and vegetables imported, by countries of origin, fiscal year 1936*—Continued

Kind	Country and quantity	Total
Sweetpotato [2] ---pounds--	China, 8,300	8,300
Swiss chard ---do---	Mexico, 25,752	25,752
Tamarind bean pod ---do---	Antigua, 78,879; Cuba, 350; India, 33,600; Mexico, 8,339; Montserrat, 3,696; St. Lucia, 7,705.	132,569
Tomato ---do---	Bahamas, 22,777; Costa Rica, 15,519; Cuba, 42,891,501; Haiti, 660; Mexico, 42,571,509; Virgin Islands, 119,308.	85,621,274
Turnip ---do---	Cuba, 19,788; Mexico, 261,944	281,732
Walnut (green in husk) ---do---	Netherlands, 80	80
Water caltrop ---do---	China, 13,320; Japan, 100	13,420
Waterchestnut ---do---	China, 2,073,008; Cuba, 90; Japan, 2,360	2,075,458
Watercress ---do---	Mexico, 5,135	5,135
Waterlily root ---do---	China, 8,181; Cuba, 52,832	61,013
Waterlily seed pod ---do---	Cuba, 18	18
Watermelon ---do---	Cuba, 295,567; Mexico, 229,388	524,955
Yam [2] ---do---	China, 32,880; Japan, 10,691	43,571
Yam bean root ---do---	China, 32,536; Mexico, 1,184	33,720

[2] Imported into Hawaii. Quarantine No. 29 prohibits importation into continental United States.

TABLE 37—*Fruits and vegetables imported, by ports of entry, fiscal year 1936*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Port and quantity	Total
Apple ---pounds--	New Orleans, 4,077; New York, 390; Philadelphia, 100.	4,567
Apricot ---do---	New York, 14,102	14,102
Aralia cordata ---do---	Hawaii (all ports), 1,625	1,625
Arrowhead ---do---	Boston, 5,500; Buffalo, 9,700; Hawaii (all ports), 33,125; New York, 23,000; Niagara Falls, 4,500; Port Huron, 600; Portland, 1,500; San Francisco, 66,800; San Pedro,[1] 2,000; Seattle, 7,297.	154,022
Artichoke, Jerusalem ---do---	Nogales, 5	5
Asparagus ---do---	Calexico, 24; New York, 73,366; San Ysidro, 10	73,400
Avocado ---do---	Boston, 25; Key West, 381,475; Miami, 107,475; New Orleans, 4,586,855; New York, 2,398,028; Tampa, 2,058,403.	9,532,261
Avocado (seed removed) ---do---	Brownsville, 21,722; Douglas, 770; Eagle Pass, 4,193; El Paso, 291; Hidalgo, 262; Laredo, 18,603; Naco, 167; Nogales, 3,796.	49,804
Balsamapple ---do---	Calexico, 1,506; El Paso, 813; New York, 16,887	19,206
Banana ---bunches--	Baltimore, 3,537,582; Boston, 3,153,224; Brownsville, 68,151; Buffalo, 950; Charleston, 1,140,828; Detroit, 4,290; Eagle Pass, 12,413; El Paso, 382,368; Galveston, 2,850,093; Gulfport, 28,873; Hidalgo, 877; Jacksonville, 415,359; Key West, 1,765; Laredo, 477,153; Miami, 248,170; Mobile, 2,184,333; Morses Line, 20; New Orleans, 14,817,984; New York, 13,340,156; Nogales, 5,412; Norfolk, 294,820; Panama City, 2,988; Philadelphia, 5,470,970; Puerto Rico (all ports), 1,401; San Francisco, 1,707,414; San Pedro [1], 1,808,513; San Ysidro, 3; Sault Ste. Marie, 2,425; Seattle, 303,737; Sumas, 900; Tampa, 666,173; Vanceboro, 2,000; Wilmington, N. C., 40,858.	52,972,203
Bean (green):		
Faba ---pounds--	Calexico, 10; Nogales, 106	116
Lima ---do---	Hidalgo, 330; Laredo, 26,268; New York, 6,571,506; Nogales, 363; San Ysidro, 1,350.	6,599,817
String ---do---	Brownsville, 467; Calexico, 2,441; Douglas, 3,375; Eagle Pass, 1,903; El Paso, 63,075; Laredo, 686,669; Naco, 922; New York, 490; Nogales, 336,693; San Ysidro, 23,801.	1,119,836
Beet ---do---	Calexico, 2,473; Douglas, 313; Eagle Pass, 510; El Paso, 173,747; Naco, 53; Nogales, 7,977; San Ysidro, 491.	185,564
Berry:		
Rubus ---do---	New York, 194; San Ysidro, 8; Seattle, 1,860	2,062
Vaccinium:		
Frozen ---do---	Boston, 597,390; Chicago, 101,200; New York, 2,077,464; Philadelphia, 379,200; Vanceboro, 115.	3,155,369
Natural ---do---	Boston, 20,950; Chicago, 391,500; Malone, 100; New York, 751,226; Port Huron, 348,300; San Francisco, 70; Seattle, 2,500; Vanceboro, 3,100.	1,517,746

[1] Harbor of Los Angeles. In reports of previous years this has been shown as Los Angeles.

TABLE 37.—*Fruits and vegetables imported, by ports of entry, fiscal year 1936*—Continued

Kind	Port and quantity	Total
Breadfruit---pounds--	New York, 1,216	1,216
Brussels sprouts---do---	Calexico, 9; New York, 216	225
Cabbage---do---	Calexico, 1,345; Douglas, 5,885; Eagle Pass, 1,298; Miami, 183; Naco, 665; New York, 200; Nogales, 17,945; Puerto Rico (all ports), 322; San Ysidro, 230.	28,073
Cacao bean pod---do---	New York, 311	311
Carrot---do---	Calexico, 4,148; Douglas, 319; Eagle Pass, 794; El Paso, 507,730; Naco, 313; Nogales, 26,026; San Ysidro, 723; Ysleta, 70.	540,123
Cassava---do---	Key West, 4,995; Miami, 175; New York, 184,896; Puerto Rico (all ports), 50.	190,116
Cauliflower---do---	Calexico, 28; Douglas, 164; Eagle Pass, 15; Nogales, 2,198; San Ysidro, 111.	2,516
Celery---do---	Calexico, 19; New York, 3,589; San Ysidro, 89	3,697
Chayote---do---	Eagle Pass, 22; El Paso, 1,189; Key West, 75; Laredo, 1,432; Miami, 2,355; New York, 16,693; Tampa, 120.	21,886
Cherry:		
Dried, sour---do---	New York, 45,172	45,172
Fresh---do---	New York, 6,439	6,439
Chinese cabbage---do---	El Paso, 980; New York, 48,757	49,737
Cipollino---do---	Boston, 17,857; New York, 1,813,884	1,831,741
Citrus medica---do---	Detroit, 80; El Paso, 3; New York, 17,721; St. Paul, 30.	17,834
Clover top---do---	Douglas, 651; Nogales, 17	668
Coriander---do---	Calexico, 299	299
Crescentia alata---do---	Nogales, 3	3
Crosnes---do---	New York, 220	220
Cucumber---do---	Calexico, 432; Douglas, 579; Eagle Pass, 14; Laredo, 148; Miami, 30,850; Naco, 104; New Orleans, 78,765; New York, 2,252,986; Nogales, 16,127; Port Everglades, 105,750; San Ysidro, 160; Tampa, 34,409.	2,520,324
Dasheen (includes colocasia, inhame, malanga, taro, and yautia), pounds.	Boston, 128,107; Buffalo, 2,000; Calexico, 116; Detroit, 400; Key West, 6,151; Miami, 460; New York, 803,582; Niagara Falls, 6,600; Portland, 7,400; Puerto Rico (all ports), 187,047; San Francisco, 288,330; San Pedro,[1] 4,100; Seattle, 100,450; Tampa, 39,081.	1,573,824
Eggplant---do---	Brownsville, 270; Calexico, 47; Eagle Pass, 5; El Paso, 6,054; Laredo, 28,068; Miami, 13,587; New Orleans, 486,270; New York, 7,616,765; Nogales, 275,849; Port Everglades, 38,000; San Ysidro, 1,693; Tampa, 179,999.	8,646,607
Endive---do---	New York, 1,291,251; St. Albans, 900	1,292,151
Euphorbia longana---do---	New York, 226	226
Garlic---do---	Boston, 25,000; Brownsville, 48,872; Calexico, 192,280; Douglas, 2,273; Eagle Pass, 17,602; El Paso, 37,772; Hawaii (all ports), 16,140; Hidalgo, 7,889; Laredo, 863,125; Naco, 705; New Orleans, 409,040; New York, 2,690,937; Nogales, 60,356; Puerto Rico (all ports), 2,512,763; San Francisco, 401; San Ysidro, 704; Ysleta, 23.	6,885,882
Genip (*Melicocca bijuga*)---do---	New York, 150	150
Ginger (crude)---do---	Boston, 6,800; Buffalo, 5,251; Calexico, 3; Detroit, 500; Hawaii (all ports), 6,400; Miami, 750; New York, 67,986; Niagara Falls, 19,500; Portland, 1,600; San Francisco, 245,884; San Pedro,[1] 13,600; Seattle, 27,573.	395,847
Grape:		
Fresh (not hothouse)---do---	Brownsville, 8,059; Calexico, 232; Eagle Pass, 236; El Paso, 275; New Orleans, 40,916; New York, 12,533,603; Nogales, 1; San Ysidro, 97.	12,583,419
Hothouse---do---	New York, 88,308	88,308
Processed---do---	New York, 6,600	6,600
Grapefruit---do---	Boston, 7,415; Key West, 215,140; Miami, 150; New Orleans, 1,121,799; New York, 2,718,538.	4,063,042
Husk tomato---do---	Brownsville, 228; Calexico, 37; Eagle Pass, 2,845; El Paso, 1,777; Laredo, 5,210; Nogales, 5.	10,102
Japanese horseradish---do---	Hawaii (all ports), 316	316
Kale---do---	New York, 146,940	146,940
Kohlrabi---do---	Calexico, 34; El Paso, 532; New York, 150	716
Kudzu---do---	Boston, 900; Buffalo, 1,300; Detroit, 100; New York, 12,357; Niagara Falls, 5,000; Portal, 70; Portland, 500; San Francisco, 38,800; Seattle, 4,100.	63,127
Lemon---do---	Boston, 42,685; Miami, 9,000; New Orleans, 75; New York, 6,344,436; San Francisco, 25.	6,396,221

[1] Harbor of Los Angeles. In reports of previous years this has been shown as Los Angeles.

TABLE 37.—*Fruits and vegetables imported, by ports of entry, fiscal year 1936*—Continued

Kind	Port and quantity	Total
Lettuce—pounds	Calexico, 1,320; Douglas, 3,920; Eagle Pass, 1,297; El Paso, 845; Laredo, 5; Naco, 270; Nogales, 34,557; San Ysidro, 617.	42,831
Lily bulb (edible)—do	Boston, 1,600; Buffalo, 760; Hawaii (all ports), 1,910; New York, 5,300; Niagara Falls, 1,615; Portland, 100; San Francisco, 12,300; Seattle, 1,530.	25,115
Lime (sour)—do	Baltimore, 1,377; Boston, 167,279; Brownsville, 408,323; Eagle Pass, 1,126,969; El Paso, 1,215,530; Hidalgo, 4,302; Key West, 963; Laredo, 5,753,035; Miami, 55,041; Naco, 25; New Orleans, 14,428; New York, 2,495,995; Nogales, 362,334; Portland, 240; Puerto Rico (all ports), 652; St. Albans, 140; San Francisco, 57,578; San Pedro,[1] 400,270; Tampa, 4,042.	12,068,523
Litchi nut—do	New York, 134	134
Mango (frozen, seed removed)—do	Portland, 15; San Pedro,[1] 320	335
Melon—do	Calexico, 1,369; Douglas, 125; Eagle Pass, 117; Laredo, 333,763; New York, 5,305,461; Nogales, 5,303; San Ysidro, 803; Sasabe, 150.	5,647,091
Mint—do	Calexico, 16; Eagle Pass, 7; El Paso, 12; New York, 290; Nogales, 5.	330
Mustard—do	Calexico, 8,448; Douglas, 306; Eagle Pass, 35; El Paso, 89,299; Naco, 30; New York, 46,382; Nogales, 3,255; San Ysidro, 25.	147,780
Nectarine—do	New York, 652,328	652,328
Nectarine (hothouse)—do	New York, 25	25
Nopale—do	Douglas, 382; Nogales, 494; San Ysidro, 6	882
Nuts:		
Acorn—do	New York, 11,435,966	11,435,966
Chestnut—do	Boston, 179,563; Hawaii (all ports), 134,345; New York, 15,288,438; Puerto Rico (all ports), 8,264; San Francisco, 244,808; San Pedro,[1] 148,382; Seattle, 63,405.	16,067,205
Okra—do	Calexico, 11; Key West, 6,000; Laredo,[2] 42,753; Miami, 19,065; New Orleans, 507,215; New York, 681,758; Nogales, 345; Tampa, 583,414.	1,840,561
Onion—do	Boston, 736,071; Calexico, 18,867; Douglas, 15,017; Eagle Pass, 6,955; El Paso, 54,066; Hawaii (all ports), 80,020; Hidalgo, 153; Laredo, 6,758; Naco, 2,710; New York, 3,089,858; Nogales, 37,520; Puerto Rico (all ports), 639; San Francisco, 12,830; San Pedro,[1] 40,943; Seattle, 76,027; San Ysidro, 669.	4,179,103
Orange:		
Under Quarantine No. 56—do	Boston, 7,475; Key West, 85; New York, 310	7,870
Mandarin (Quarantine No. 28)—do	Ketchikan, Alaska, 45; Portland, 236,348; Seattle, 2,067,404.	2,303,797
Papaya—do	Miami, 116,794; New Orleans, 590; New York, 8,339; Tampa, 16,786.	142,509
Parsley—do	Calexico, 17; Douglas, 294; Eagle Pass, 20; El Paso, 10,386; Naco, 5; Nogales, 3.	10,725
Pea—do	Calexico, 310; Douglas, 2,153; El Paso, 96; Laredo, 200; Naco, 280; New York, 4,049; Nogales, 2,971,968; San Ysidro, 21,637.	3,000,693
Peach—do	New York, 131,377	131,377
Pear—do	New York, 757,576	757,576
Pepper—do	Brownsville, 3,562; Calexico, 3,074; Douglas, 9,872; Eagle Pass, 41,318; El Paso, 392,612; Hidalgo, 943; Laredo, 190,208; Miami, 14,097; Naco, 2,305; New Orleans, 154,838; New York, 5,544,325; Nogales, 4,981,783; Port Everglades, 17,000; Puerto Rico (all ports), 100; San Ysidro, 36,687; Sasabe, 50; Tampa, 15,376; Ysleta, 70.	11,408,220
Pigweed—do	Douglas, 767; Naco, 50; Nogales, 80	897
Pineapple—crates	Brownsville, 6,105; Calexico, 1; Detroit, 364; Eagle Pass, 8,655; El Paso, 23,290; Key West, 460; Laredo, 73,736; Miami, 10,147; Naco, 1; New Orleans, 138,684; New York, 210,547; Nogales, 278; Port Everglades, 449,169; Puerto Rico (all ports), 12; Roma, 1; San Francisco, 46; San Pedro,[1] 42; Tampa, 11,000.	932,538
Plantain—pounds	Baltimore, 2,800; Key West, 255,910; Miami, 167,198; New Orleans, 646,114; New York, 4,403,014; Philadelphia, 2,500; Puerto Rico (all ports), 5,038,476; San Francisco, 11,550; Seattle, 3,500; Tampa, 776, 917.	11,307,979

[1] Harbor of Los Angeles. In reports of previous years this has been shown as Los Angeles.
[2] Okra was admitted from Tamaulipas, Mexico, through the port of Laredo under special conditions.

TABLE 37.—*Fruits and vegetables imported, by ports of entry, fiscal year 1936*—Continued

Kind	Port and quantity	Total
Plum ---- pounds	New York, 112,082	112,082
Potato:		
Under Quarantine No. 56 ---- do	Boston, 4,700; New York, 1,056,727	1,061,427
Under potato regulations ---- do	Calexico, 1,739; Douglas, 43,224; Miami, 71,395; Naco, 5,160; New York, 2,578,950; Nogales, 112,402; Puerto Rico (all ports), 77,103; Washington, D. C., 10.	2,889,983
Pricklypear ---- do	Calexico, 26; Eagle Pass, 25; El Paso, 1,343; Laredo, 1,355; Nogales, 81; San Ysidro, 10.	2,840
Pumpkin ---- do	Calexico, 4,334; Douglas, 1,892; Eagle Pass, 41; Key West, 6,490; Laredo, 7,101; Naco, 860; New York, 179,664; Nogales, 217; Puerto Rico (all ports), 78,819; San Ysidro, 1,614; Sasabe, 200; Tampa, 2,158.	283,390
Purslane ---- do	Calexico, 807; Nogales, 849	1,656
Radish ---- do	Calexico, 2,472; Douglas, 233; Eagle Pass, 40; El Paso, 136,373; Naco, 10; New York, 24,244; Nogales, 6,317; San Ysidro, 105; Ysleta, 3.	169,797
Rhubarb ---- do	San Ysidro, 5	5
St. Johns bread ---- do	New Orleans, 33,600; Newport News, 56,000; New York, 1,035,322; Norfolk, 336,000; Philadelphia, 5,500.	1,466,422
Salsify ---- do	San Ysidro, 2,985	2,985
Spinach ---- do	Calexico, 3,151; Douglas, 2,239; El Paso, 41,101; Naco, 135; New York, 93; Nogales, 20,707; San Ysidro, 162; Ysleta, 27.	67,615
Squash ---- do	Calexico, 4,811; Douglas, 11,952; Eagle Pass, 2,428; El Paso, 28,260; Laredo, 53,546; Naco, 1,145; New Orleans, 3,015; New York, 54,379; Nogales, 35,985; San Ysidro, 1,561; Sasabe, 300; Tampa, 330; Ysleta, 34.	197,746
Strawberry ---- do	El Paso, 16,788; Laredo, 2,800; New York, 10; Nogales, 264; San Ysidro, 16.	19,878
Sweetpotato ---- do	Hawaii (all ports), 8,300	8,300
Swiss chard ---- do	El Paso, 25,752	25,752
Tamarind bean pod ---- do	Calexico, 21; Eagle Pass, 173; El Paso, 5,570; Laredo, 2,231; Miami, 40; New Orleans, 90; New York, 124,100; Nogales, 63; San Francisco, 280; San Ysidro, 1.	132,569
Tomato ---- do	Brownsville, 17,464; Buffalo, 20,810; Calexico, 12,379; Douglas, 25,124; Eagle Pass, 44,069; El Paso, 829,862; Hidalgo, 108,417; Laredo, 1,995,372; Miami, 28,163; Naco, 3,570; New Orleans, 1,578,300; New York, 38,880,142; Nogales, 35,657,000; Port Everglades, 1,689,798; Puerto Rico (all ports), 33,985; San Francisco, 435,525; San Pedro [1], 4,248,830; San Ysidro, 1,987; Sault Ste. Marie, 1,425; Seattle, 1,981; Tampa, 6,877; Ysleta, 194.	85,621,274
Turnip ---- do	Calexico, 233; Douglas, 66; Eagle Pass, 85; El Paso, 258,479; New York, 19,788; Nogales, 2,877; San Ysidro, 149; Ysleta, 55.	281,732
Walnut (green in husk) ---- do	New York, 80	80
Water caltrop ---- do	Hawaii (all ports), 4,270; New York, 5,050; Niagara Falls, 700; San Francisco, 3,400.	13,420
Waterchestnut ---- do	Boston, 50,600; Buffalo, 48,501; Detroit, 23,000; Hawaii (all ports), 114,886; New York, 343,290; Niagara Falls, 82,400; Port Huron, 12,500; Portland, 14,710; San Francisco, 623,346; San Pedro,[1] 106,600; Seattle, 655,625.	2,075,458
Watercress ---- do	Calexico, 33; Douglas, 328; Naco, 110; Nogales, 4,656; San Ysidro, 8.	5,135
Waterlily root ---- do	New York, 52,832; San Francisco, 2,300; Seattle, 5,881.	61,013
Waterlily seed pod ---- do	New York, 18	18
Watermelon ---- do	Calexico, 6,467; Douglas, 7,094; El Paso, 11,500; Miami, 11,110; Naco, 585; New Orleans, 59,880; New York, 216,967; Nogales, 201,860; San Ysidro, 1,682; Sasabe, 200; Tampa, 7,610.	524,955
Yam ---- do	Hawaii (all ports), 43,571	43,571
Yam bean root ---- do	El Paso, 768; Hawaii (all ports), 3,100; Laredo, 416; New York, 500; Niagara Falls, 200; San Francisco, 28,636; Seattle, 100.	33,720

[1] Harbor of Los Angeles. In reports of previous years this has been shown as Los An geles.

PLANTS AND PLANT PRODUCTS ENTERED FOR EXPORTATION OR FOR TRANSPORTATION AND EXPORTATION

In addition to the regulated imports for consumption entry recorded in tables 26 to 37, this Bureau supervised the entry under permit, either for exportation or for transportation and exportation, of considerable quantities of plants and plant products, as follows: Flower bulbs, corms, and tubers, 814,187 pieces, 155,586 pounds, 3,154 cases[1] and 3 bags;[1] fruit trees, 34,000 and 1 bale;[1] cacti, 12,182 pieces, 874 pounds; orchids, 400 and 2 cases;[1] miscellaneous plants, 60,544 and 11 cases[1] and 2 boxes;[1] nut and palm seeds, 33,505 pounds and 4 bags;[1] apples, 200 cases[1] and 79,232 pounds; arrowhead, 3 baskets[1] and 7,572 pounds; bamboo shoots, 100 pounds; carrots, 116 pounds; celery, 83,930 pounds; chayotes, 24 pieces; chestnuts, 1 basket[1] and 165 pounds; cipollini, 50 cases[1] and 116,296 pounds; *Citrus medica*, 60 pounds; cucumbers, 5,000 pounds; dasheens, 69 baskets,[1] 1 case,[1] and 4,512 pounds; eggplants, 64,600 pounds; garlic, 1,867,041 pounds; ginger, 2 baskets[1] and 2,850 pounds; grapes, 249,488 pounds; grapes, hothouse, 266 pounds; grapefruit, 14,471,630 pounds and 11 cases;[1] kudzu, 1,935 pounds; lemons, 40 boxes[1] and 1,542,807 pounds; lerens, 38 pounds; limes, sour, 22,362 pounds; lily bulbs, edible, 3 baskets[1] and 515 pounds; melons, 38,480 pounds; nectarines, 9,900 pounds; onions, 5,351,929 pounds; oranges, 2,456,473 pounds; oranges, bitter, 94,980 pounds; oranges, mandarin, 55,623 pounds; peas, 685,340 pounds; peppers, 31,321 pounds; pineapples, 12 pieces and 134,141 crates; potatoes, 1,011,721 pounds; tamarind bean pods, 29,270 pounds; tomatoes, 15,272,437 pounds; waterchestnuts, 4,614 pounds; waterlily root, edible, 3,110 pounds; bagging, 1,315 bales; broomcorn, 6,615 bales; broomcorn brooms, 72; shelled corn, 2,268,552 pounds; sorghum seed, other than Sudan grass seed, 80 pounds; Sudan grass seed, 51,750 pounds; cotton, 188,242 bales, including 3,967 bales of linters; cotton waste, 1,409 bales; cotton samples, 208; cottonseed, 1,239,877 pounds; cottonseed cake, 7,099,146 pounds; cottonseed meal, 1,161,353 pounds; cottonseed oil, 51,500 gallons; seed or paddy rice, 11 pounds; tea cake made of paddy rice, 1,500 pounds; rice straw, 600 bales; rice-straw whisk brooms, 432; and sugarcane, 3,980 pounds.

MARITIME PORT INSPECTION

SHIP INSPECTION

The ship inspection has been continued along the lines described in previous annual reports. Ships from foreign countries, and also those from Hawaii and Puerto Rico, are inspected promptly upon arrival for the presence of prohibited and restricted plant material in ships' stores, passengers' and crews' baggage, quarters, and cargo.

The inspection at ports in California, Florida, Hawaii, and at certain ports in Puerto Rico has been performed by State and Territorial officials serving as collaborators of the Bureau of Entomology and Plant Quarantine.

A record by ports of the ship inspection appears in table 38. This table differs from the ship-inspection table appearing in previous annual reports in that the column which heretofore indicated the number of ships "with contraband" has been changed to show the number of ships carrying prohibited plant material. In previous years both prohibited and restricted plant material for which a permit had not been secured were considered as contraband. Inasmuch as the pest risk assumed with restricted plant material is apparently very small, it seemed advisable to eliminate such material from consideration in this table and report only ships carrying prohibited plant material.

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[1] Information as to exact quantity not available.

TABLE 38.—*Number of ships inspected, fiscal year 1936*

Port	From foreign ports											
	Direct			Via United States ports			Via Hawaii			Via Puerto Rico		
	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material
Baltimore	555	554	223	743	734	296				3	3	1
Bellingham	261	53	9									
Boston	1,353	1,347	473	376	375	145						
Brunswick [1]	7	7	6									
Buffalo	7	7	3	1	1	0						
Charleston	174	174	76	139	138	51	1	1	1			
Chicago	10	10	8	9	9	7						
Detroit	20	20	15									
Eureka [2]	3	3	1	2	2	1						
Galveston	275	256	112	457	456	227				5	5	0
Gulfport [3]	18	18	15	110	53	38						
Honolulu [2]	234	234	100	2	2	0						
Houston	391	391	316	447	444	187						
Jacksonville [2]	272	272	15	160	160	0						
Key West [2]	207	207	108	63	63	3						
Miami [2]	1,044	1,041	283	28	27	0						
Mobile	171	171	86	362	338	185						
New Orleans	1,258	1,256	615	512	512	278				2	2	0
Newport News [2]	59	58	32	438	426	56						
New York	3,651	3,603	2,076	945	768	354				133	133	96
Norfolk	236	236	117	783	767	354				1	1	0
Pensacola [2]	47	47	24	229	229	84				1	1	0
Philadelphia	726	726	336	1,023	1,022	531				3	3	2
Port Arthur	391	391	328	355	345	119				1	1	1
Portland, Oreg	59	59	39	413	412	247						
Port San Luis [2]	49	49	11									
Puerto Rico (all ports)	1,110	1,099	374									
San Diego [2]	1,083	1,083	19	49	49	0						
San Francisco [2]	331	331	111	813	813	210	99	99	66			
San Pedro [2]	1,531	1,529	761	507	506	108	94	94	54	10	10	8
Savannah	93	93	51	235	232	118						
Seattle	1,288	1,186	143	320	320	150	1	1	0			
Tampa [2]	299	299	104	325	325	75						
Ventura [2]	2	2	2									
West Palm Beach [2]	108	108	7	3	3	0						
Total	17,323	16,920	6,999	9,849	9,531	3,824	195	195	121	159	159	108

Port	From Hawaii						From Puerto Rico						From United States ports		
	Direct			Via United States ports			Direct			Via United States ports			Via Panama Canal		
	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material	Arrived	Inspected	With prohibited material
Baltimore				31	31	0	9	9	1	29	29	2	245	241	8
Boston				20	20	0	20	20	2				233	233	0
Charleston							4	4	1	29	29	0	80	80	2
Eureka [2]				4	4	0							1	1	1
Galveston				1	1	0	12	12	0	8	8	0	17	17	3
Gulfport [3]										5	2	0			
Honolulu [2]													125	117	3
Houston	2	2	1	2	2	0	9	9	0	11	11	0	52	52	0
Jacksonville [2]							29	29	3	4	4	0	44	44	2
Miami [2]													1	1	0
Mobile				1	1	0	10	10	1	48	48	6	67	67	2
New Orleans	11	11	8	13	13	3	21	21	4	48	48	2	61	61	7
Newport News [2]													17	15	0
New York	7	5	0	44	40	2	118	118	23	23	12	0	363	266	2
Norfolk							4	4	1	47	47	0	156	156	4
Pensacola [2]										4	4	0			
Philadelphia	1	1	0	29	29	0	50	50	11	10	10	1	413	410	5
Port Arthur				2	2	0	7	7	2	3	3	0	16	15	0
Portland, Oreg	1	1	0	8	8	0							236	157	0
Port San Luis [2]	10	10	1										2	2	0
Puerto Rico (all ports)													14	14	8
San Diego [2]	13	13	1										147	147	6
San Francisco [2]	165	165	34	36	36	13							609	609	16
San Pedro [2]	70	70	23	31	31	9	1	1	0				789	787	64
Savannah							11	11	0	13	13	0	52	52	1
Seattle	4	4	1	17	17	0							133	133	0
Tampa [2]							30	30	2	2	2	0			
Ventura [2]	4	4	1												
Total	288	286	70	239	235	27	335	335	51	284	270	11	3,873	3,677	134

[1] Work handled by inspector stationed at Savannah, Ga.
[2] Collaborators stationed at these ports.
[3] Work handled by inspectors stationed at Mobile, Ala.

NOTE.—The foreign-ship arrivals do not in all cases agree with customs figures. Foreign ships may put in for bunkers and be inspected by inspectors of the Bureau of Entomology and Plant Quarantine but not entered by customs. On the other hand, ships entered at certain small subports are included in customs records but not in this report.

CARGO INSPECTION

All importations of plants and plant products subject to plant-quarantine restrictions are inspected at the port of entry or the port of first arrival. A record of such importations by ports appears in table 39.

TABLE 39.—*Inspection of shipments of plants and plant products offered for entry, fiscal year 1936*

Port	Shipments inspected and entered under permit	Shipments refused entry	Port	Shipments inspected and entered under permit	Shipments refused entry	Port	Shipments inspected and entered under permit	Shipments refused entry
	Number	*Number*		*Number*	*Number*		*Number*	*Number*
Baltimore	252	1	Houston	77	3	Presidio	9	0
Bellingham [1]	36	0	Jacksonville [3]	52	0	Puerto Rico(all ports).	472	0
Blaine	82	0	Key West [3]	189	0	Rio Grande City.[4]	5	0
Boston	1,545	1	Laredo	3,446	0	Roma	12	0
Brownsville	1,007	0	Mercedes	9	0	San Diego [3]	3	0
Buffalo [2]	652	9	Miami [3]	859	2	San Francisco [3]	1,169	19
Calexico	513	0	Mobile	102	0	San Pedro [3]	628	11
Charleston	114	0	New Orleans	2,124	2	San Ysidro	60	0
Chicago	37	1	New York	12,562	44	Savannah	26	0
Detroit	538	9	Nogales	3,518	11	Seattle	849	2
Douglas	32	0	Norfolk	196	1	Tampa [3]	922	0
Eagle Pass	624	0	Pensacola [3]	1	0			
El Paso	4,892	0	Philadelphia	502	4			
Galveston	223	0	Port Arthur	7	0			
Hidalgo	440	0	Port Huron [3]	97	1	Total	39,458	165
Honolulu [3]	468	42	Portland, Oreg.	107	2			

[1] Includes entries made at Sumas.
[2] Includes entries made at Niagara Falls.
[3] Collaborators stationed at these ports.
[4] Port closed Apr. 28, 1936.

In addition to the importations credited to the Mexican border ports, there were several thousand importations which were so small that no duty was assessed by customs and no record of them kept. All of these small importations, however, were carefully inspected before being released. Considerable time was also devoted at several ports to the inspection of miscellaneous cargoes to determine their true status and to the supervision of the cleaning of shipments containing prohibited packing material or contaminated with objectionable material such as soil.

DISINFECTION

Disinfection is required of certain commodities as a condition of entry and of other commodities when inspection reveals the presence of injurious insects or plant diseases. During the fiscal year 1936 the following plant material was treated under the supervision of inspectors of this Bureau: Cotton, 141,972 bales; cotton waste, 77,398 bales; cotton linters, 18,546 bales; parcels of cotton, cotton linters, cotton waste, and bagging, 2,071; broomcorn, 3,827 bales; rice fiber, 1,552 bales; grapes, 3,711 barrels and 10 half barrels; chestnuts, 4,733 cases and barrels; cipollini, 3,448 containers; seeds, 425 containers; miscellaneous plants, 461 lots; narcissus bulbs imported under special permit, 200,878; and bulbous iris, 950,881.

In addition to the above, various shipments of plant material and cotton samples were treated at the inspection house in Washington, D. C., as shown in table 44. The record of cotton samples in this table refers to parcels containing samples of cotton, cotton linters, and cotton waste.

AIRPLANE INSPECTION

The two outstanding incidents in connection with airplane inspection during the fiscal year 1936 were the establishment of airplane service with the Orient, by way of Hawaii and the Philippine Islands, and the inauguration of regular service between Germany and the United States by means of the new airship *Hindenburg*.

During the fiscal year a total of 2,996 airplanes arriving from foreign countries and Hawaii were inspected. These airplanes arrived at the following 16 ports of entry: Nogales and Naco, Ariz.; Calexico, Los Angeles, San Francisco, and San Diego, Calif.; Miami and West Palm Beach, Fla.; Boston, Mass.; Philadelphia, Pa.; San Juan, P. R.; Brownsville, El Paso, Laredo, and Presidio, Tex.; and Seattle, Wash.

A total of 1,168 interceptions of prohibited and restricted plant material were taken from 722 airplanes.

FOREIGN PARCEL-POST INSPECTION

Through cooperation with customs and post-office officials, mail packages from foreign countries which are found to contain plants or plant products are referred to inspectors of this Bureau for examination. Such packages arriving at ports of entry where no plant-quarantine inspectors are stationed are forwarded to the nearest port where inspection can be made.

There was a decided increase in this activity during the year, as indicated by the total number of packages inspected at all ports, 191,740, compared with 107,450 for the fiscal year 1935. A record by port of the number and disposition of the foreign parcel-post packages inspected appears in table 40.

TABLE 40.—*Foreign parcel-post packages inspected, fiscal year 1936*

Port	Inspected	Refused entry (entire or in part)	Diverted to Washington	Port	Inspected	Refused entry (entire or in part)	Diverted to Washington
	Number	*Number*	*Number*		*Number*	*Number*	*Number*
Atlanta [1]	65	7	24	Naco	43	0	0
Baltimore	1,440	50	201	New Orleans [4]	187	26	47
Boston	13,792	73	2,776	New York	120,213	1,408	6,206
Brownsville	624	5	0	Nogales	660	16	7
Buffalo	1,037	36	346	Philadelphia	8,726	161	1,231
Chicago	12,580	384	391	Portland, Oreg. [5]	135	13	1
Detroit	3,693	105	164	Puerto Rico (all ports)	18	3	0
Eagle Pass	515	1	0	St. Paul	12,231	131	100
El Paso [2]	735	141	39	San Diego [1]	84	3	0
Honolulu [1]	1,152	46	0	San Francisco [1]	5,303	99	1
Houston	193	2	14	Seattle	1,700	56	0
Jacksonville [1]	243	42	34	Tampa [1]	6	5	0
Laredo	477	47	7	Washington, D. C.	1,274	20	0
Los Angeles [1] [3]	4,497	99	1				
Miami [1]	117	72	10	Total	191,740	3,051	11,600

[1] Collaborators are stationed at these ports.
[2] 49 packages diverted to San Francisco for disposition.
[3] 245 packages diverted to San Francisco for disposition.
[4] 6 packages diverted to San Francisco for disposition.
[5] 5 packages diverted to Seattle for disposition.

Following the policy adopted last fiscal year, shamrocks, which are permitted entry through the mails provided they are free from soil, are included in table 42. Of the number of packages listed as inspected the following represent shamrocks: Baltimore, 148; Boston, 9,500; Chicago, 5,510; Detroit, 640; Los Angeles, 602; New York, 51,745; Philadelphia, 2,128; St. Paul, 345; San Francisco, 892; Seattle, 95.

MEXICAN-BORDER SERVICE

A total of 27,259 freight cars entered the United States from Mexico during the year. This represents a decrease of 3,477 from the fiscal year 1935, which may be accounted for, in a large part, by the decrease in the entry of corn and other feeds for which there was an unusual demand during the drought conditions of 1934. However, the number of cars requiring fumigation as a condition of entry continued to increase, as has been the case during each successive year since 1933. A total of 8,181 cars were fumigated during the year, representing an increase of 1,340 cars, or 19+ percent, over the number fumigated during the fiscal year 1935. All cars found to be contaminated with cottonseed were required to be cleaned before entry was permitted. The usual

fee of $4 was charged for each car fumigated, and all fees collected were covered into the Treasury as miscellaneous receipts.

A summary of the railway-car inspection and fumigation is shown in table 41. In addition to the freight cars listed in this table, 3,891 Pullman and passenger coaches entered and were inspected at the following ports: Eagle Pass, 12; El Paso, 1,268; Laredo, 2,210; Naco, 3; Nogales, 392; and Presidio, 6.

TABLE 41.—*Inspection and fumigation of railway cars crossing the border from Mexico, fiscal year 1936*

Port	Cars inspected	Cars with cotton-seed	Cars entered	Cars fumigated	Fees collected
	Number	*Number*	*Number*	*Number*	*Dollars*
Brownsville	596	14	584	198	792
Douglas	1,269	6	1,269	33	132
Eagle Pass	2,311	135	2,218	898	3,500
El Paso	7,293	301	6,885	[1] 1,833	7,852
Laredo	8,603	873	8,162	3,743	14,816
Naco	500	3	500	4	16
Nogales	6,354	118	6,181	1,410	5,600
Presidio	333	29	333	[2] 62	248
Total	27,259	1,479	26,132	8,181	[3] 32,956

[1] Includes 13 cars not from Mexico.
[2] Includes 3 cars not from Mexico.
[3] The apparent discrepancy in fees collected and the number of cars fumigated may be explained by the fact that it is customary for the railroad to purchase fumigation coupons in advance.

Plant-quarantine inspectors at Mexican-border ports take an active part in cooperation with the Customs Service in the inspection of vehicles, baggage, personal effects, and express packages from Mexico. A total of 230,464 pieces of baggage and 3,513,283 vehicles were inspected. As usual this inspection resulted in the interception of a considerable quantity of prohibited and restricted plant material. A record of these interceptions will be found in table 46.

INSPECTION IN PUERTO RICO AND HAWAII

The inspectors stationed in Puerto Rico are called upon to enforce the provisions of Quarantine No. 58, governing the movement of fresh fruits and vegetables to the mainland, in addition to the enforcement of foreign plant quarantines and regulations as they affect the entry of foreign plants and plant products into the island. Valuable assistance is rendered by insular inspectors serving as collaborators in that portion of the work pertaining to the enforcement of the foreign plant quarantines. Inspections are made in the fields, in packing houses, and on the docks of such fruits and vegetables as are permitted to move to the mainland under the provisions of Quarantine No. 58, and all shipments of such commodities are certified as free from pests.

Inspection is also made of parcel-post packages originating on the island and destined for points in continental United States. A total of 4,001 packages were inspected and 355 were found to contain prohibited or restricted plant material and were returned to the sender. A record by month of the amounts of fruits and vegetables inspected and certified for shipment to the mainland appears in table 42.

TABLE 42.—*Summary of shipments of fruits and vegetables moving from Puerto Rico to the mainland, inspected and certified under Quarantine No. 58, fiscal year 1936*

Product	July	August	September	October	November	December	January	February	March	April	May	June	Total
Avocados---pounds	120		450	40									610
Bananas---bunches	16	23	26	6	9					2	12	11	105
Breadfruit---pounds	3,215	3,380	2,290	460	1,330	210		630		200	250	2,890	14,855
Cabbage---do							2,820						2,820
Carrots---do							80	960	1,260				2,300
Celery root---do	875	1,430	247	600	1,150	870	490		660	1,060	1,570	1,420	10,372
Chayotes---do	2,425	3,560	3,250	5,960	9,930	3,840	2,660	1,160	2,240	2,250	545		37,820
Citrons---do		1,200	600									80	1,880
Cucumbers---do					77,870	641,150	891,650	546,950	426,000	111,900	100		2,695,620
Cucumbers (Angola)---do			12			60							72
Dasheens---do	16,380	27,525	12,589	8,165	17,995	11,825	13,035	45,969	42,535	25,070	18,975	12,640	252,703
Eggplants---do						2,750	4,900	5,450	3,750	1,810			18,660
Ginger root---do	10,800	17,790	9,066	4,740	8,480	3,330	6,080	10,480	6,950	2,000	7,090	6,165	92,971
Grapefruit---do	3,842,460	3,099,420	6,651,620	2,890,710	1,404,630	414,360	273,690	955,260	2,433,060	3,392,100	3,525,480	3,271,770	32,154,560
Lemons---do			90										90
Lerenes---do					180	175	40	420	260	150			1,225
Lima beans---do						770	560	1,470	910				3,710
Limes---do	13,140	20,960	22,410	22,590	29,610	9,810	1,440	540	1,100	270	2,700	7,920	132,490
Mixed---do	2,140	2,480	650	1,440	1,340	5,980	450	900	1,020	360	630	1,525	18,915
Okra---do										1,600	1,828		3,428
Oranges---do		180	270	124,650	111,240	41,670	54,720	23,130	22,680	3,060	180		381,780
Papayas---do		545	1,939	700	1,540	1,405	490	330	2,450	770	4,335	120	14,624
Parsley---do	1,265	1,545	2,055	2,000	2,775	2,170	1,695	2,450	1,300	1,925	2,350	3,025	24,555
Peas (garden)---do					22,540		665	4,130	6,615	1,225			35,175
Peppers---do	210	1,520	1,300	1,575	7,385	27,920	56,070	64,805	80,635	54,985	14,130	1,770	312,305
Peppers (small)---do	265	105		145	35	270	140		210	350	140	805	2,465
Pigeon peas---do						43,165	25,620	36,960	22,390	14,070			142,205
Pineapples---crates	14,044	13,814	8,144	654	634	333	186	18,832	76,827	130,261	141,531	31,163	436,423
Pineapples---half crates	2,565	2,132	1,623	1,321	6,537	5,922	2,429	13,409	14,629	19,530	11,367	5,115	86,579
Plantains---pounds		54,205	33,050	16,670	6,160		110						110,195
Potatoes---do								16,500	8,100				24,600
Pumpkins---do	11,915	19,355	23,328	31,870	21,210	16,460	20,635	27,335	15,115	6,460	7,705	1,130	202,518
Quenepas---do	960	3,385	206									420	4,971
Squash---do					1,610	30,310	60,130	19,880	30,450	6,770			149,150
String beans---do					8,365	7,875	13,755	71,575	20,825				122,395
Sweet corn---do							600					50	650
Tamarinds---do	1,485								300	2,220	1,260	740	6,005
Tangerines---do					18,810	7,290							26,100
Tomatoes---do					500	6,500	4,325	25,675	59,275	11,250	4,650		112,175
Watermelons---do									5,410	420			5,830
Yams---do	18,790	57,195	64,100	54,245	80,500	39,040	23,700	47,230	45,170	31,280	25,405	15,630	502,285
Yuca---do						390							390
Certificates	258	274	276	211	248	231	220	294	313	368	412	255	3,360

In Hawaii the enforcement of the foreign-plant quarantines is handled wholly by insular inspectors serving as collaborators. The inspectors of this Bureau are engaged in the enforcement of Quarantine No. 13 on account of the Mediterranean fruitfly and the melon fly in Hawaii. Inspections are made in the fields, in packing sheds, and on the docks, of such fruits and vegetables as are permitted to move to the mainland under the provisions of Quarantine No. 13.

Inspections are also made of parcel-post packages originating in Hawaii and destined for mainland points. A total of 109,616 packages were opened and examined, 111,503 were inspected without being opened, and 106 packages were found to contain prohibited plant material. These figures represent a considerable increase over the fiscal year 1935.

The inspection and sealing of baggage as an accommodation to travelers between Hawaii and the mainland was continued during the fiscal year 1936. A total of 3,303 pieces of baggage was inspected and sealed under this arrangement. A record, by months, of the amounts of fruits and vegetables inspected and certified for shipment to the mainland appears in table 43.

TABLE 43.—*Fruits and vegetables inspected and certified for shipment from Hawaii to the mainland, fiscal year 1936*

Month	Arrowhead	Asparagus	Bananas	Cassava	Coconuts	Ginger root	Kudzu	Lily roots [1]	Peanuts	Pineapples	Potatoes	Swamp cabbage	Taro	Water chestnuts	Yams	Yam bean roots	Permits issued
	Pounds	*Pounds*	*Bunches*	*Pounds*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Crates*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Number*
July			7,077		14	3,100		12,390		5,634		1,760	4,200				150
August			7,122		323	1,785		28,440		5,049		1,600	7,125			79	171
September			9,792		1,034	2,338	25	21,450	10	2,733		1,400	4,730	30		495	140
October		120	9,206		10,100	375		15,650		3,109		380	2,220		860		81
November	100	534	14,435		1,062	18,350		22,100		7,070			1,620		710	250	144
December		736	11,223		7,303	9,374		59,300		5,486			506		560		145
January		632	9,021	125	296	4,259		2,750		4,902	48,076				540	1,020	131
February		578	10,430		140	4,200		28,802		7,908	748,269				1,030	1,100	115
March			9,217		2,738	3,420		22,950		3,051	966,141	190	15			500	140
April			8,258		338	2,000		25,650		6,564	272,972	480	20		2,600		125
May			12,907		377			30,325		7,480		2,080	2,800				181
June			8,576		249	1,800		15,900		5,123		1,840	5,650			780	169
Total	100	2,600	117,264	125	23,974	51,001	25	285,707	10	64,109	2,035,458	9,730	28,886	30	6,300	4,224	1,692

[1] The edible root (*Nelumbium nelumbo*) is also well known to the trade as lotus root.

INSPECTION OF SPECIAL-PERMIT AND DEPARTMENTAL PLANT MATERIAL

As in previous years, all plants imported under special permit have been inspected at ports of entry designated for such material. A record of material imported under special permit is presented in table 31. The majority of such special-permit importations have been, as in former years, inspected at Washington, D. C., and these, together with departmental importations and distributions from Washington, including domestic plants entering and leaving the District of Columbia, are inspected and certified for shipment at the Department inspection house, in the nursery, or in freight, express, or post offices. A summary of the inspections made at Washington, D. C., is given in table 44.

TABLE 44.—*Summary of plants and plant products offered for inspection in the District of Columbia, fiscal year 1936*

Material inspected	Foreign	Domestic	Fumigated	Otherwise treated	Infested with insects	Infected with diseases
Lots of seeds (departmental)	5,275	6,089	4,079	617	448	71
Plants, cuttings, bulbs, roots, rhizomes, etc. (departmental)	16,200	276,218	4,623	18,757	[1] 321	[1] 153
Miscellaneous unclassified material, other than plants and seeds (departmental)	180	83	88	1	4	4
Shipments of plants under regulation 14, Quarantine No. 37 (commercial)	1,606	-------	315	150	436	337
Shipments of plants and plant products under regulations 3 and 15, Quarantine No. 37 (commercial)	767	-------	290	95	97	42
Containers of domestic plants other than departmental (mail, express, freight, and truck)	-------	10,151	-------	8	14	6
Shipments of plants by private individuals	-------	3,502	9	23	45	19
Interceptions of plants and plant products at Washington, D. C	1,189	-------	87	43	24	4
Interceptions of plants and plant products referred to Washington, D. C	1,793	-------	403	506	168	37
Parcels of cotton samples referred to Washington, D. C	21,928	-------	21,928	-------	-------	-------

[1] Lots.

INSPECTION OF PLANT-INTRODUCTION AND PROPAGATING GARDENS

As heretofore, plants grown and distributed by the Bureau of Plant Industry from its plant-introduction and propagating gardens were inspected and certified prior to shipment. Plants shipped from Mandan, N. Dak., Coconut Grove, Fla., and Chico, Calif., were inspected by officials of the States concerned, cooperating with this Bureau. Those distributed from Savannah, Ga., were examined by an inspector of this Bureau. Table 45 indicates the number of plants inspected and certified for distribution.

TABLE 45.—*Plants, budsticks, cuttings, tubers, roots, and shipments of seeds examined for distribution from plant introduction and propagating gardens, fiscal year 1936*

Station	Plants	Budsticks, cuttings, tubers, and roots	Shipments of seeds	Station	Plants	Budsticks, cuttings, tubers, and roots	Shipments of seeds
Bell, Md	53,856	501	6	District of Columbia	9,224	15,803	7,659
Chico, Calif	7,407	776	114	Mandan, N. Dak	760,490	-------	-------
Coconut Grove, Fla	4,969	545	49				
Savannah, Ga	1,572	1,516	1	Total	837,518	19,141	7,829

INTERCEPTIONS OF PROHIBITED AND RESTRICTED PLANTS AND PLANT PRODUCTS

The inspection of ships, vehicles, cargo, baggage, ships' stores and quarters, and foreign mail at the maritime and Mexican-border ports resulted in the interception of large quantities of prohibited and restricted plant material. Many of these interceptions were found to harbor insect pests and plant diseases; many others, while showing no infestation or infection, must be consid-

ered potentially dangerous, since they are known hosts of pests in the country of origin. In classifying the interceptions, those made at bridges, ferries, and crossings at the Mexican and Canadian border ports have all been considered as having been taken from baggage.

A record of the number of interceptions of prohibited and restricted plant material appears in table 46.

TABLE 46.—*Number of interceptions of prohibited and restricted plants and plant products, fiscal year 1936*

Port	In baggage		In cargo		In mail		In quarters		In stores		Total	
	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted
Baltimore	15	15	52	2	50	1	69	17	142	14	328	49
Bellingham	0	4	------	------	------	------	0	3	3	0	3	7
Blaine	887	866	------	------	------	------	------	------	------	------	887	866
Boston	92	121	8	0	28	69	8	1	8	1	144	192
Brownsville	3,084	549	------	------	5	0	------	------	------	------	3,089	549
Brunswick [1]	------	------	------	------	------	------	2	0	0	1	2	1
Buffalo [2]	3	359	1	3	10	27	------	------	------	------	14	389
Calexico	2,023	81	------	------	------	------	------	------	------	------	2,023	81
Charleston	7	4	4	0	------	------	40	2	7	1	58	7
Chicago	------	------	5	0	268	171	------	------	------	------	273	171
Del Rio	474	45	------	------	------	------	------	------	------	------	474	45
Detroit	51	444	9	8	59	53	------	------	------	------	119	505
Douglas	572	134	------	------	------	------	------	------	------	------	572	134
Eagle Pass	1,194	183	------	------	1	0	------	------	------	------	1,195	183
El Paso	7,411	950	------	------	124	24	------	------	------	------	7,535	974
Galveston	11	5	------	------	------	------	92	10	17	0	120	15
Gulfport [3]	1	0	------	------	------	------	6	17	12	0	19	17
Hidalgo	926	156	------	------	------	------	------	------	------	------	926	156
Honolulu [4]	752	202	103	1	69	3	2	0	7	0	933	206
Houston	0	1	1	0	------	------	299	4	28	0	328	5
Jacksonville [4]	------	------	------	------	30	5	7	8	12	3	49	16
Key West [4]	98	279	6	0	------	------	0	13	19	7	123	299
Laredo	6,568	782	------	------	31	5	------	------	------	------	6,599	787
Los Angeles [4]	------	------	------	------	83	18	1	0	------	------	84	18
Mercedes	164	41	------	------	------	------	------	------	------	------	164	41
Miami [4]	939	794	19	8	49	25	533	629	59	13	1,599	1,469
Mobile	15	9	1	1	------	------	105	6	46	5	167	21
Naco	114	41	------	------	------	------	------	------	------	------	114	41
New Orleans	475	365	13	3	11	5	764	31	116	3	1,379	407
New York	1,624	1,363	524	187	580	915	214	61	141	5	3,083	2,531
Nogales	2,969	827	------	------	10	8	------	------	------	------	2,979	835
Norfolk	2	6	3	0	------	------	91	51	36	2	132	59
Pensacola [4]	------	------	------	------	------	------	16	2	15	0	31	2
Philadelphia	32	10	10	2	110	110	95	13	109	12	356	147
Port Arthur	44	2	------	------	------	------	892	17	84	0	1,020	19
Port Huron [4]	2	136	------	------	------	------	------	------	------	------	2	136
Portland, Oreg	0	1	5	1	12	1	1	1	10	2	28	6
Presidio	210	26	------	------	------	------	------	------	------	------	210	26
Puerto Rico (all ports)	125	57	------	------	------	------	2	3	2	0	129	60
Rio Grande City [5]	17	9	------	------	------	------	------	------	------	------	17	9
Roma	122	40	------	------	------	------	------	------	------	------	122	40
St. Paul	------	------	------	------	42	93	------	------	------	------	42	93
San Diego [4]	10	1	------	------	------	------	7	2	31	9	48	12
San Francisco [4]	185	7	14	3	18	12	163	7	145	5	525	34
San Pedro [4]	510	63	13	2	------	------	56	6	175	12	754	83
San Ysidro	7,392	968	------	------	------	------	------	------	------	------	7,392	968
Savannah	1	0	------	------	------	------	63	0	9	0	73	0
Seattle	95	28	1	0	19	13	1	0	6	0	122	41
Tampa [4]	2	4	0	7	------	------	14	0	27	0	43	11
West Palm Beach [4]	------	------	------	------	------	------	6	8	2	1	8	9
Ysleta [6]	238	13	------	------	------	------	------	------	------	------	238	13
Total	39,456	9,991	792	228	1,609	1,558	3,549	912	1,268	96	46,674	12,785

[1] Work handled by inspector stationed at Savannah, Ga.
[2] Includes interceptions made at Niagara Falls.
[3] Work handled by inspectors stationed at Mobile, Ala.
[4] Collaborators stationed at these ports.
[5] Port closed Apr. 28, 1936.
[6] Port closed Feb. 7, 1936, and since that date inspectors from El Paso have worked 1 shift on each Saturday and Sunday.

PESTS INTERCEPTED

During the year the inspectors and collaborators of the Bureau collected from foreign plants and plant products insects belonging to 1,798 recognized species and others distributed among 1,604 genera and families, fungi and bacteria belonging to 324 recognized species, plant-parasitic nematodes belonging to 7 recognized species, and numbers of interceptions of diseases caused by fungi, bacteria, nematodes, or other agents that could be referred to family, genus, or other group only. Many of these interceptions were of considerable economic or scientific importance.

A total of 81,263 interceptions of insects and plant diseases were made during the year. A summary of the interceptions appears in table 47.

TABLE 47.—*Interceptions of insects and plant diseases made during the fiscal year 1936*

Port	Cargo		Stores		Baggage		Quarters		Mail		Total	
	Insects	Diseases	Insects	Diseases	Insects	Diseases	Insects	Diseases	Insects	Diseases	Insects	Diseases
Baltimore	882	46	408	535	27	9	654	31	68	27	2,039	648
Bellingham	8	8	4	1	0	0	1	0	0	0	13	9
Blaine	5	0	0	0	20	10	0	0	0	0	25	10
Boston [1]	49	51	176	188	65	21	18	10	44	12	352	282
Brownsville	946	192	25	42	4,988	1,780	85	6	2	1	6,046	2,021
Buffalo	32	37	2	2	2	1	1	0	23	4	60	44
Calexico	19	1	0	0	54	9	0	0	0	0	73	10
Charleston	690	2	5	19	0	1	7	3	0	0	702	25
Chicago	14	9	0	4	0	0	0	0	30	18	44	31
Del Rio	0	0	0	0	50	7	0	0	0	0	50	7
Detroit	35	54	4	8	3	5	0	0	13	10	55	77
Douglas	8	1	4	0	61	2	0	0	0	0	73	3
Eagle Pass	308	50	2	0	140	22	0	0	0	0	450	72
El Paso	688	124	1	0	759	282	0	1	4	4	1,452	411
Galveston	1,235	10	53	227	5	0	15	0	0	0	1,308	237
Hidalgo	43	8	0	0	380	192	0	0	0	0	423	200
Honolulu	160	0	9	0	86	0	52	0	105	0	412	0
Houston	12	4	50	553	1	0	8	12	0	0	71	569
Jacksonville [2]	2	1	13	57	0	0	1	0	0	2	16	60
Key West [2]	2	1	5	3	7	1	0	0	0	0	14	5
Laredo	2,514	49	0	0	838	12	0	0	4	0	3,356	61
Los Angeles [2]	0	0	0	0	0	0	0	0	2	0	2	0
Mercedes	0	0	0	0	48	71	0	0	0	0	48	71
Miami [2]	163	22	78	16	357	12	257	8	15	1	870	59
Mobile [3]	731	8	145	409	4	2	45	8	0	0	925	427
Naco	0	0	0	0	18	2	0	0	0	0	18	2
New Orleans	5,077	320	278	768	73	18	282	74	29	3	5,739	1,183
New York	8,060	5,859	4,848	2,580	1,973	1,133	992	381	2,123	272	17,996	10,225
Nogales	3,676	1,028	3	7	526	98	0	0	3	1	4,208	1,134
Norfolk	163	22	89	502	0	1	19	21	0	0	271	546
Pensacola [2]	5	2	32	40	1	0	6	0	0	0	44	42
Philadelphia	976	282	364	1,178	28	31	76	85	147	101	1,591	1,677
Port Arthur	0	0	114	322	1	0	76	7	0	0	191	329
Portland	6	13	10	15	0	0	5	4	4	1	25	33
Presidio	1	0	0	0	32	1	0	0	0	0	33	1
Rio Grande City [4]	0	1	0	0	5	3	0	0	0	0	5	4
Roma	1	0	0	0	25	14	0	0	0	0	26	14
St. Paul	0	0	0	0	0	0	0	0	1	0	1	0
San Diego [2]	0	0	105	12	3	0	6	0	5	0	119	12
San Francisco [2]	3,213	597	208	24	1,131	26	327	6	770	104	5,649	757
San Juan	49	10	21	5	39	16	4	0	9	3	122	34
San Pedro [2]	450	2	358	109	211	11	10	1	0	0	1,029	123
San Ysidro	35	7	0	0	103	13	0	0	0	0	138	20
Savannah	1	0	14	21	2	0	4	0	0	0	21	21
Seattle	236	60	80	34	89	11	163	22	34	38	602	165
Tampa [2]	19	11	14	22	1	1	1	0	0	0	35	34
Washington, D. C	981	322	0	0	29	16	0	0	1,121	354	2,131	692
Ysleta [5]	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous	2	1	0	0	0	0	0	0	0	0	2	1
Total	31,497	9,215	7,522	7,703	12,185	3,834	3,115	680	4,556	956	58,875	22,388

[1] Includes interceptions at Providence, R. I.
[2] Collaborators stationed at these ports.
[3] Includes interceptions at Gulfport, Miss.
[4] Closed Apr. 28, 1936.
[5] Closed Feb. 7, 1936.

NOTE.—Inspectors stationed at Puerto Rico made 28 interceptions of insects and 2 interceptions of plant diseases during their field and packing-house inspection of fruits and vegetables for shipment to the mainland. One insect interception was taken from mail destined for the mainland.

CERTIFICATION FOR EXPORT

At the beginning of the year certain changes were made in the organization of the export-certification service. Two supervisors were designated, one for the western area and the other for the eastern area, for the purpose of coordinating the shipping-point inspections. This arrangement has already resulted in a more uniform application of existing standards of inspection, as is reflected by the decreased number of rejections of American fruit in foreign markets.

There was a decided increase in export certification over the preceding fiscal year. A total of 9,099 certificates, representing 3,740,495 containers of plants and plant products, were issued to meet the sanitary requirements of foreign countries. This represents an increase of 2,192, or 32 percent, in the number of certificates issued, and 948,466, or 34 percent, in the number of containers certified for export.

Certificates were issued at 29 ports, covering 59 different commodities which were exported to 65 foreign countries or possessions. A few of the more important commodities inspected and certified were: Apples, 3,007 shipments, consisting of 1,707,428 boxes, 66,687 barrels, and 89,664 baskets; oranges, 595 shipments, consisting of 346,844 boxes; pears, 1,096 shipments, consisting of 622,006 boxes; potatoes, 1,514 shipments, consisting of 575,899 bags, 22,137 barrels, and 3,216 crates; miscellaneous fruits and vegetables, 1,436 shipments, consisting of 85,745 containers.

The certification of apples and pears was conducted cooperatively with the Bureau of Agricultural Economics.

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